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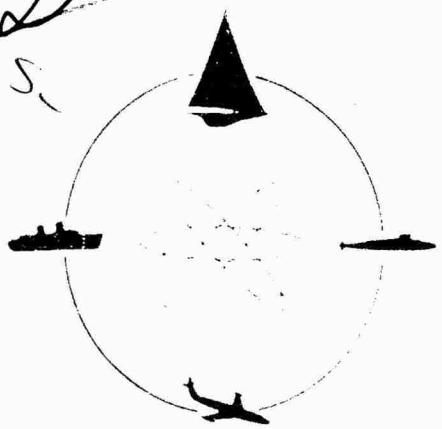

DAVIDSON LABORATORY

REPORT SIT-DL-77-1957
November 1977

HYDRODYNAMIC MODEL EVALUATION OF THE MCDEC LVA DESIGN CONCEPT IN CALM WATER AND HEAD SEAS

by

P. Ward Brown and W.E. Klosinski

Prepared for
Marine Corps Development and Education Command
under
Office of Naval Research Contract
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(Davidson Laboratory Project 4519/026)

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The results of hydrodynamic model tests of a new planing design concept for the LVA are presented and analyzed. Rough water performance in head seas, seakeeping and habitability characteristics are discussed. Optimum LCG and transom flap deflection are selected and satisfactory performance is demonstrated over the speed range. Attention is drawn to the possibility of air ingestion by the water jet pump.

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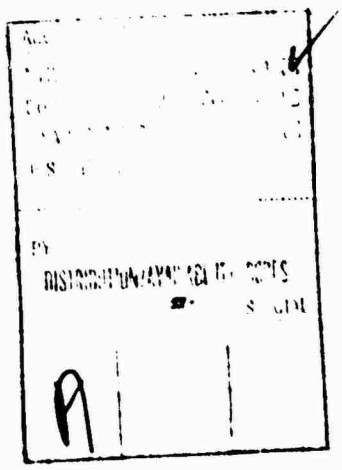

Approved

Daniel Savitsky
Deputy Director

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APPENDIX A

INTRODUCTION

A new design concept for the Landing Vehicle Assault (LVA) has been developed by the Marine Corps Development and Education Command (MCDEC). This planing hull has an overall length of 31 ft. 8 in. with transom flap retracted and a beam of 11 ft. A unique feature of this design is the large full-span transom flap which increases the overall length to 35 ft. 9 in. when deployed in the water. The twin waterjets are installed on the trim flap. The hull lines in the bow area have inverted-vee sections, washing out to relatively low deadrise aft. The design is intended to operate without auxiliary hydrodynamic surfaces and there is no provision for either bow flaps or chine flaps. This concept is designed to make best use of the space available within the profile, to have improved performance due to increased length and reduced impact loads due to the bow lines.

The MCDEC LVA design concept differs significantly from other LVA designs that have been model tested. Consequently a program of model tests was undertaken to document the performance and seakeeping characteristics of the MCDEC LVA, and allow comparison with other LVA design concepts.

MODEL

A 1/12-scale model was built to MCDEC Dwg. No. 760305; a sketch of this design showing the principal features is included on Figure 1. The model was constructed of high density polyurethane foam, reinforced with fiberglass sheet and covered with glass cloth and resin. The model dimensions corresponded to an overall length of 35.75 ft, including the adjustable 4.92 ft full-span flap, a beam of 11 ft and a depth of 8 ft. The prototype depth is 6.6 ft and the model height was increased to provide added freeboard for testing purposes; this added height was

painted black, whereas the rest of the model was red. The bottom of the model was painted with black lines at 1 inch intervals from the transom for the purpose of estimating wetted areas from underwater photographs.

The model was towed through a reference point, which was the center of moments in the fixed-trim tests and the pitch axis in the free-to-trim tests. This reference point corresponded to a position 12.06 ft forward of the transom (LCM) and 3.45 ft above the baseline (VCM). Ballast weights were adjusted in the model to achieve a pitch radius of gyration equal to 25% of the overall length about the CM. Accelerometers were mounted in the model for rough water tests, at the driver's station, forward end of the troop compartment, LCM and the aft end of the troop compartment located 20.4 ft, 17.1 ft, 12.06 ft and 2 ft respectively forward of the transom.

APPARATUS AND INSTRUMENTATION

Smooth Water, Fixed Trim Tests

The model tests were carried out in Davidson Laboratory's Tank 3 facility. Figure 2 shows the fixed trim test setup of the MCDEC LVA model. The model was free-to-heave, but was restrained in yaw, roll, sway and trim. The dual heave masts, which translated vertically through teflon roller bearings, incorporated a drag balance at their base capable of measuring up to 50 lb of drag. This apparatus in turn was coupled to the model through a pitch moment balance and adjustable trim-locking block. The trim axis was located at the pitch moment center: 12.06 feet forward of the transom and 3.45 feet above the baseline.

The apparatus included an unloading arm for adjusting the vertical load on the water and a remotely-controlled pickup mechanism for raising and lowering the model relative to the free water surface before and after each run.

In addition to the drag and pitch moment transducers in the balances, a trim inclinometer was used to set the trim and measure the running trim angle. A heave transducer recorded the vertical motion of the trim axis.

The signals from the transducers were relayed by overhead cables to the data station on shore where they were filtered (40 Hz low pass) and processed by an on-line PDP-8e computer, which includes an analog-to-digital converter. The results were printed on a teletype and stored on digital magnetic tape. All data channels were monitored on an oscillograph.

An underwater picture setup was stationed along the tank in the data gathering section. This included a mirror on the tank bottom for directing a view upwards to the model to obtain wetted lengths; samples of the pictures obtained are included on Figures 3 and 4.

Smooth and Rough Water, Free-to-Trim Tests

For these tests the pitch moment balance and trim block were removed from the model and replaced with a pitch pivot box whose vertical axis was 3.45 feet above the baseline. A rotary transducer measured the pitch motion. A wave strut mounted forward and to port of the MCDEC model was used for checking the number of waves encountered during each run.

The Tank 3 plunger-type wave maker located at the far end of the tank was used to produce a reproducible series of 100 irregular waves having a variance density corresponding to the Pierson-Moskowitz spectrum. A stationary wave wire was installed mid-way in the tank to calibrate the wave spectra used in these tests. The spectrum used in these tests had a significant height of 2.2 ft and is compared with the Pierson-Moskowitz spectrum on Figure 5.

A bow quarter view of the model negotiating waves was taken through a black and white television camera, and a video-tape recording was made of each run. Color motion pictures were also taken of the model running in waves and an edited film of these runs composed.

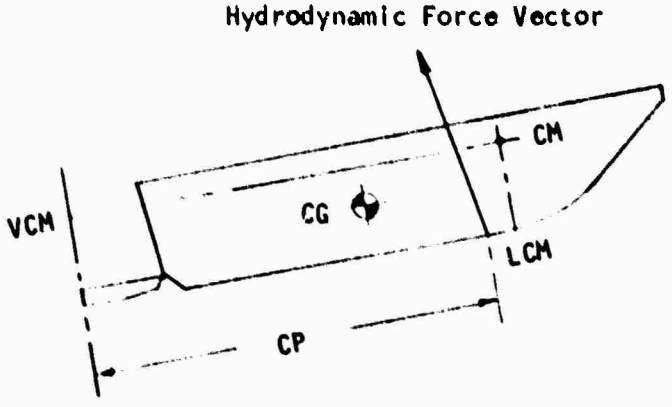
The on-line PDP-8e computer was used to analyze the filtered time histories (40 Hz low pass) which were recorded simultaneously on analog magnetic tape and on an oscillograph.

DATA PROCESSING

The instrumentation was calibrated by applying known displacements to the motion transducers and wave strut, known loads to the drag balance, and gravity multiples to the accelerometers. All calibrations were processed by the on-line computer. All calibrations were linear and a "least-squares" technique was used to determine the calibration rates, which were spot-checked daily.

The primary measured quantities included the drag, trim, draft, pitching moment for the fixed-trim tests and the accelerations in rough water. The velocities were computed from the time taken to travel through the measuring sections which was 50 ft for the calm water tests and 140 ft for the rough water tests. During data collection all data channels were scanned at a rate of 250 Hz and the results stored in the computer for appropriate processing.

The position of the center of pressure (CP) was calculated for all runs using the mean trim and either the mean pitching moment or the CG position for the fixed and free-to-trim tests respectively. The center of pressure is defined as the intersection of the resultant hydrodynamic force vector with the baseline and its position is measured from the trailing edge of the flap along the baseline.



(Sketch not to scale)

For the free-to-trim tests

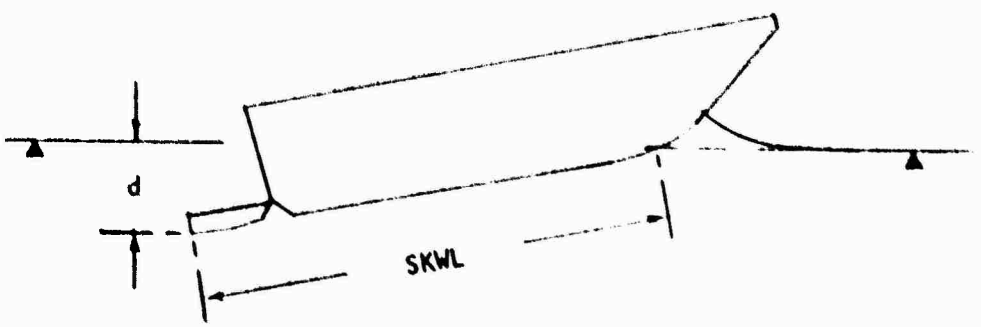
$$CP = \frac{LCG + LCM(D/L)\tan\tau - VCG\tan\tau + VCM(D/L)}{1 + (D/L)\tan\tau}$$

and for the fixed-trim tests

$$CP = LCM + \frac{M + VCM(D\cos\tau - L\sin\tau)}{L\cos\tau + D\sin\tau}$$

where CM = center of moments, tow point and pitch pivot
L = lift = weight in free-to-heave tests
D = drag
M = hydrodynamic pitching moment about CM
τ = trim

The mean draft and trim readings were used to calculate the "static keel wetted length," that is the wetted length without allowing for wave rise.



The static keel wetted length is found by solving the equation

$$SKWL = \frac{d - \cos\tau\, k(SKWL)}{\sin\tau}$$

where d = draft
τ = trim
k(x) = equation of keel profile

For a straight keel [k(x)=0] the "static" wetted length is simply given by d/sinτ. The static wetted length was subsequently correlated with the dynamic wetted length determined from the underwater photographs.

For the irregular wave tests the mean values described above were computed and in addition a peak-trough analysis was carried out for the pitch, heave and four accelerations. The heave is defined as the excursion of the CM relative to the still water surface. Tne peak-trough analysis computes for each signal the mean and rms, the number of oscillations, the average of the peaks and troughs, the average of the 1/3-highest and the 1/10-highest peaks and troughs and the extreme values of the peaks and troughs. These are output in a two-line format: mean/rms and peak/trough. In the statistical analysis spurious oscillations are suppressed by means of "buffers." (Buffers are selected so as to prevent the detection of substantial maxima and minima in corresponding steady-state calm water runs. A substantial maximum (minimum) is defined as any maximum (minimum) succeeded by a decrease (increase) in signal level at least equal to the magnitude of the stipulated buffer size.) Typical buffers employed in these tests were 0.5 degree pitch, 0.1 inch heave, 0.25 g acceleration, and 0.2 inch wave. In addition, for selected runs, spectral analyses of the vertical accelerations were performed and converted to 1/3-octave rms format for comparison with the habitability criteria.

TEST PROGRAM AND PROCEDURE

The test program included irregular head-sea tests and calm water fixed-trim tests. All tests were made with the model free-to-heave.

Head Sea Tests

The bulk of the rough water tests were run at a gross weight of 55,000 lb, speeds of 20, 25, 30 and 35 mph and at LCG positions relative to the transom of 9.06, 10.56 and 12.06 ft. At each speed and LCG position the transom flap angle was varied so as to define a minimum drag. Transom flap angles up to 15 degrees were used with the aft CG, and up to 5 degrees with the forward CG. In addition tests were made at a weight of 60,000 lb, speeds of 20, 25, 30 and 35 mph, at an LCG of 12.06 ft for flap settings of 0 and 5 degrees.

All head sea tests were run in the same irregular wave having a significant height of 2.2 ft. In addition to the above main program, low speed tests were run at 55,000 lb displacement, with the LCG at 10.56 and 12.06 ft, with zero flap deflection and at speeds of 5, 8, 11, 14 and 17 mph.

Measured quantities included the speed, resistance, pitch and heave motions and accelerations at the driver's position, forward troop compartment, nominal LCG (12.06 ft forward of transom) and the aft troop compartment. Derived quantities included the center of pressure position and the static keel wetted length.

Calm Water Fixed Trim Tests

The main calm water test program was run using the fixed-trim, constant-load test technique. This is also known as the general planing test technique. The data obtained in this manner provides the broadest characterization of planing craft; allows for changes in load, CG position and shaft line position, and provides the basis for the most accurate expansion of the data to full-scale. The equilibrium running attitude of the craft is determined from the expanded full-scale data allowing for thrust unloading and thrust moment.

The objectives of the calm water test program included: the determination of the relationship between the static keel wetted length (SKWL) and the dynamic wetted length determined from underwater photographs; the determination of the relationship between trim and wetted length for a range of load; the determination of the variation of center of pressure with wetted length, and the determination of the added lift, drag and pitching moment due to flap deflection.

These relationships are desirable in order to expand the data from model scale to full size. The mean static keel wetted length can be measured in rough water as well as calm water and hence, from the calm water tests, the dynamic wetted length and area in waves may be determined. This allows the direct expansion of the rough water resistance without the need to determine the added resistance in waves. A knowledge of the effect

of load on the wetted length for given trim provides the basis for allowing for the effect of the thrust vector on load as well as providing for a range of gross weights. The location of the hydrodynamic center of pressure is needed to provide for a range of CG and thrust vector positions. Characterization of the forces and moments generated by flap deflection provides for performance prediction at arbitrary flap angle.

The bulk of the calm water fixed trim tests of the MCDEC LVA was carried out for the following matrix of conditions:

Load, lb	44,375, 62,125
Speed, mph	20, 25, 30, 35
Trim, degrees	6, 8, 10, 12
Flap deflection, degrees	0, 5, 10

With zero flap deflection, the load range was subsequently expanded and covered in more detail, providing for loads from 30,000 lb to 80,000 lb in increments of 9,000 lb; in these tests the dynamic wetted length was not measured. This set of data was obtained with the object of systemizing the data (curve fitting) and automating the process of data expansion. This objective was not attained within the scope of this program, however the data is included in the results and could be used as the basis of an automated program if the need arises.

Measured quantities included speed, trim, transom draft, dynamic wetted length, resistance and pitching moment. Derived quantities included the center of pressure position and the static wetted length.

RESULTS AND DISCUSSION

The rough water data obtained with the MCDEC model has been expanded to full-scale and is presented in Table 2 for a gross weight of 55,000 lb at speeds of 20, 25, 30 and 35 mph and flap angles of 0, 2, 4 and 6 degrees. This data covers a range of LCG from approximately 7 to 13 ft forward of the transom. This presentation makes full allowance for the effect of the thrust vector which moves with the transom flap, including unloading due

to the vertical component of the thrust and pitching due to the angle of the thrust. The method of expansion is described in the Appendix where the raw model data is also presented.

The tabulated values at each speed cover a range of trim for each flap angle and show the corresponding full-scale resistance and the LCG position required to balance the craft at each trim. As a measure of the craft's acceleration the average 1/10-highest acceleration at the driver's station is included in the table for speeds of 25, 30 and 35 mph.

The resistance and acceleration as functions of LCG position are shown graphically on Figures 6 to 9, with flap deflection as parameter, for speeds of 20, 25, 30 and 35 mph. This presentation shows that in order to keep the accelerations low, the CG should be as far forward as possible and that at a given LCG increasing flap deflection decreases the accelerations. A too forward LCG, however, causes a rapid rise in drag due to wetting of the bow, for example see Figure 8, and may be expected to lead to spray and visibility problems especially at hump speed.

As far as drag alone is concerned, a combination of aft CG and positive flap angle results in the lowest drag. Both these actions tend to lift the bow out of the water and the positive flap angle actually permits operation at lower trim (more forward CG) before the bow wetting supervenes.

It is clear that at 35 mph, Figure 9, operation at the minimum drag condition would result in large accelerations. In order to reduce the accelerations the CG must be moved forward and this forward movement is limited, not so much by the drag increase at 35 mph as by the drag increase at the hump speed of 20 mph. An attempt to illustrate this situation has been made on Figure 10 where contours of constant LCG position and constant flap deflection are shown on a grid of driver's acceleration at 35 mph versus resistance at 20 mph. As the LCG is moved forward at zero flap deflection, the high speed acceleration drops rapidly at first with little increase in hump drag while later there is more penalty in hump drag for a given reduction in acceleration. At the other extreme with 4 degrees flap deflection, shifting the CG forward to reduce the acceleration is relatively costly in hump drag.

A compromise between the conflicting demands of low accelerations at cruise speed and low hump drag, depends on the weights assigned to these two characteristics. It is assumed that preference should be given to lowering the acceleration, which potentially can be reduced more than 40 percent, rather than the hump drag which at best can only be reduced 10 percent. The lowest acceleration is attained with 4 degree flap deflection at a 12 ft LCG, however at this condition the 35 mph drag is 12,600 lb which seems too high: the available thrust at this speed is of the order of 13,500 lb. The point at 4 degree flap and 11.5 ft LCG is eliminated for similar reasons. The next choice is 2 degree flap deflection at 11.5 ft LCG. This combination appears satisfactory at all speeds and has the advantage that the flap setting can be fixed throughout the speed range. The low speed data for the 11.5 ft LCG and 2 degree flap setting is given in Table 2.5.

Rough Water Performance

The rough water performance characteristics of the MCDEC LVA, in head seas having a significant wave height of 2.2 ft, at a gross weight of 55,000 lb, 11.5 ft LCG with 2 degree flap deflection are shown on Figure 11.

The maximum resistance of 14,200 lb occurs at a speed of 20 mph and the resistance decreases to 10,800 lb at the cruise speed of 35 mph. These drag values do not include allowance for windage. The maximum mean trim is 8.6 degrees at 24 mph, falling to 7.2 degrees at 35 mph. A 25 percent thrust margin at 20 mph would allow the craft to accelerate from 15 to 25 mph in about 6 seconds. With water jet propulsion this level of thrust would require a power input to each pump of approximately 1,200 SHP. The thrust available at 35 mph would then be about 14,000 lb giving a thrust margin of 30 percent at cruise speed.

Rough Water Motions and Accelerations

For the MCDEC LVA at 55,000 lb gross weight, 11.5 ft LCG, 2 degree flap deflection, in head seas having a significant wave height of 2.2 ft, the accelerations at the driver's station, forward troop compartment, nominal CG and aft troop compartment location are given in Table 3. These locations are 20.4, 17.1, 12.06 and 2 ft respectively from the transom. The accelerations have been processed by a 1/3-octave rms analysis and the results for each station are given for speeds of 25, 30 and 35 mph. Also included in the table are the total rms acceleration and the average 1/3 and 1/10-highest accelerations; the significant motion double amplitudes are included in Table 3.3.

The variation of the significant motion double amplitudes with speed is shown on Figure 12. The minimum motions occur at 20 mph when the craft pitches ± 2.5 degrees and heaves ± 0.6 ft. The motions increase at lower and higher speeds: to ± 3.25 degrees and ± 0.9 ft at 35 mph and to similar amplitudes at 10 mph.

The variation of the average 1/10-highest accelerations at four locations as a function of speed is shown on Figure 13. As would be expected the maximum accelerations occur at 35 mph amounting to 2.5 g for both the driver and the forward end of the troop compartment. The driver's acceleration is reduced to 1.9 g by slowing down to 30 mph and is 1.1 g at 25 mph. At 35 mph the average 1/3 and 1/10-highest acceleration are linearly related to the rms acceleration:

$$n_{1/3} = 4.49\ (RMS - 0.11)$$

$$n_{1/10} = 7.16\ (RMS - 0.14)$$

These equations apply to all locations at 35 mph and have a precision of ± 10%.

Since the largest accelerations are experienced by the driver, the 1/3-octave rms accelerations at the driver's station are shown on Figure 14 for speeds of 25, 30 and 35 mph. Also shown on this plot is the ISO[1] "fatigue decreased proficiency" boundary for one hour exposure,

together with the proposed[2] "10% motion sickness incidence line" for one hour exposure applicable to frequencies less than 1.0 Hz.

It is evident that the 35 mph ride quality at the driver's station is satisfactory by the ISO criterion, due primarily to the fact that the driver is 10 ft aft of the bow. The fact that at 2 Hz the rms acceleration is 1.4% above the ISO value of 1.7 m/s^2 should not be a matter for concern. The rms acceleration in each 1/3-octave is a statistical estimate and like all such estimates is subject to variation. In fact for the estimates shown on Figure 14 the 90% confidence bounds are ± 25% of the values plotted. Thus at 35 mph and a frequency of 2 Hz, there is a 90% probability that the rms acceleration will lie anywhere in the range 1.29 to 2.16 m/s^2. Consequently no particular significance should be attached to the observed value of 1.724 m/s^2.

It may be noted that the peak in the rms acceleration at 0.8 Hz corresponds to the peak in the wave spectrum at 0.25 Hz. Moreover it can be shown that when proper allowance for the effect of speed on the frequency of encounter is made, the 1/3-octave rms acceleration in each 1/3-octave band is only dependent on the total rms acceleration.

The variation of total rms acceleration with longitudinal position is shown on Figure 15 for speeds of 20, 25, 30 and 35 mph. At 35 mph if the driver were located 6 ft further forward the rms acceleration would increase 35%, raising his average 1/10-highest acceleration from 2.6 to 3.5 g, and result in a marginal ride quality as judged relative to the ISO guideline.

Flow and Spray Characteristics

The general behavior of the MCDEC LVA as regards spray and deck wetness may be judged from the motion picture that forms part of this report and has been supplied to the Marine Corps Development and Education Command. This film shows the model running at constant speeds corresponding to 5 to 35 mph, including an accelerated run from 0 to 35 mph at 0.7 fps^2 (corresponding to a thrust margin of 8% at hump), in head seas at a weight of 55,000 lb with an LCG of 10.56 ft.

Due to the aft CG location chosen for this film the trims are somewhat higher and the motion excursions more pronounced than they would be with the recommended LCG of 11.5 ft.

In viewing this film it should be noted that the bottom of the black band visible on the model represents the top of the deck of the MCDEC LVA. The craft rides comfortably at 5 mph while at 10 mph water is occasionally taken on the deck. At 15 mph spray is occasionally thrown well above deck level but forward and to the side. This spray is noticeably higher at 20 mph, however there seems to be no evidence of deck wetting. The craft is riding high with no spray problems at 25 and 30 mph but the burble at the forefoot may be expected to lead to air ingestion due to the inverted-vee bow. The craft looks very clean at 35 mph.

The problem of air entrainment under the hull is of concern for all craft employing water jet propulsion, especially those with either flat or inverted-vee bottoms. This situation is illustrated by Figures 3 and 4. These underwater pictures were taken in calm water at speeds corresponding to 20 and 25 mph. The boat was at light load, 44,375 lb with the transom flap deflected 10 degrees. Even in calm water it is evident that the bow ingests a significant amount of air and it should be noted that there is a ventilation bubble at the flap hinge line. Since the pump intakes are located at the leading edge of the transom flap, ventilation in this area is likely to degrade pump performance. In the absence of the transom flap, ventilation in this area would be expected due to the discontinuity in the buttock lines, see Figure 1. With the transom flap in place it should act as an effective ventilation plate against atmospheric air. The source of air for the ventilation bubble is not certain: it could come from the flap hinge on the model which was tight but not sealed, alternatively the bubble might be fed by the entrained air from the bow. This problem is likely to be more severe in full-scale where there is more air dissolved in sea water than in the tank water.

CONCLUDING REMARKS

Model tests of the MCDEC LVA design concept have been conducted in calm water and head seas having a significant wave height of 2.2 ft, in order to provide a basis for comparison with other LVA designs.

At a gross weight of 55,000 lb it is found that optimum performance of the craft, aimed at minimizing both high-speed accelerations and hump drag, is obtained with an LCG 11.5 ft forward of the transom and a transom flap deflection of 2 degrees throughout the speed range. The lift-drag ratio at the hump is 3.9. The hump speed of 20 mph corresponds to a volume Froude number of 1.7 and, at the hull slenderness ratio of 3.4, it is considered that the lift-drag ratio of 3.9 is the best that can be expected of this class of hull. This low hump drag is obtained with the tracks retracted and the track-wells completely sealed and dry. If the tracks were flooded the resultant loss of buoyancy would be expected to degrade the hump drag. The good performance at the hump is due to the easy bow lines and the increase in length provided by the large retractable transom flap. The installation of the twin water jets on the transom flap results in the thrust vector rotating as the flap is deflected, however it is found that the change in trimming moment due to this rotation is insignificant. With sufficient power installed to obtain a 25 percent thrust margin at hump speed, the thrust margin at 35 mph is expected to be of the order of 30 percent. With this amount of power the MCDEC LVA design could be expected to attain a maximum speed exceeding 40 mph but only at the cost of raising the driver's acceleration from 2.5 to 3.5 g.

The accelerations at the driver's station at 35 mph in Sea State 2 are found to be acceptable by the ISO standard. The driver is located 20 ft forward of the transom. Since the accelerations fall off toward the stern and all occupied spaces are aft of the driver, it follows that the ride quality is acceptable for all personnel. The accelerations diminish as the speed is reduced and slowing down from 35 to 25 mph reduces the accelerations by a factor of 2.5. The accelerations are

of the order of 20% smaller than those found for the FSHV[3] at the same relative location in either craft. Heaving and Pitching motion amplitudes seem to be similar to those found for FSHV.

Observations of the craft running in waves give the impression that this is a relatively clean hull, allowing for the fact that it is short and heavily loaded. There is little evidence of green water on the deck. At 25 mph when the bow impacts waves, the bow spray is thrown very high but appears to be appropriately deflected forward and to the side.

Even in the tank with its relatively de-aerated water substantial foaming action takes place in the inverted-vee of the bow suggesting air ingestion. The underwater pictures taken in calm water confirm that substantial amounts of air are entrained and swept aft under the hull and a ventilation bubble exists at the flap hinge line immediately in front of the pump intakes. The performance of the pumps under these conditions is a matter for concern.

ACKNOWLEDGEMENT

The authors would like to recognize the contribution of Mr. S.M. Hickson of the Marine Corps Development and Education Command, who designed the MCDEC LVA planing craft, witnessed some of the tests and acted as technical consultant for this study.

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TABLE 1

LEADING PARTICULARS OF MCDEC LVA

Displacement, lb	55,000
Beam, ft	11.0
Length with transom flap retracted, ft	31.67
Length overall, including transom flap, ft	35.75
Center of gravity	
Forward of transom, LCG, rt	11.50
Above baseline, VCG, ft	3.45
Pitch radius of gyration, ft	9.0
Transom flap	
Span, ft	11.0
Area, sq.ft.	52.0
Static floatation	
Trim, degrees	0.5
Transom draft, ft	3.4

TABLE 2.1

ROUGH WATER RESISTANCE OF MCDEC LVA
AT 55,000 lb DISPLACEMENT

Speed: 20 mph

Flap Deflection degrees	Trim degrees	LCG* ft	Resistance lb
0	6.0	12.7	14,870
	8.0	11.9	14,660
	10.0	11.2	14,280
	12.0	10.4	14,060
2	6.0	12.0	14,394
	8.0	11.3	14,060
	10.0	10.6	13,750
	12.0	9.7	13,650
4	4.0	12.4	14,890
	6.0	11.3	13.870
	8.0	10.6	13,520
	10.0	10.0	13,240
	12.0	8.9	13,190
6	4.0	11.6	14,600
	6.0	10.6	13,540
	8.0	10.1	13,110
	10.0	9.2	12,930

*Distance forward of transom

TABLE 2.2

ROUGH WATER RESISTANCE OF MCDEC LVA
AT 55,000 lb DISPLACEMENT

Speed: 25 mph

Flap Deflection degrees	Trim degrees	LCG ft	Resistance lb	Driver's Acceleration Avg. 1/10 Highest g
0	8.0	13.3	14,160	0.85
	9.0	12.5	13,540	1.05
	10.0	11.8	12,920	1.27
	11.0	11.0	12,760	1.55
	12.0	10.3	12,930	1.85
2	8.0	12.1	12,920	1.00
	9.0	11.3	12,350	1.22
	10.0	10.6	12,210	1.50
	11.0	9.8	12,310	1.80
	12.0	9.2	12,950	2.15
4	6.0	12.2	13,800	0.75
	7.0	11.5	12,690	0.94
	8.0	10.8	12,040	1.18
	9.0	10.1	11,791	1.48
	9.5	9.8	11,730	1.65
	10.0	9.4	11,720	1.85
	10.5	9.1	11,980	2.04
6	5.0	11.6	14,360	0.63
	6.0	11.0	12,730	0.85
	7.0	10.4	11,860	1.10
	8.0	9.7	11,370	1.45
	9.0	8.9	11,200	1.85
	9.5	8.6	11,440	2.10
	10.0	8.2	11,790	2.37

TABLE 2.3

ROUGH WATER RESISTANCE OF MCDEC LVA
AT 55,000 lb DISPLACEMENT

Speed: 30 mph

Flap Deflection degrees	Trim degrees	LCG ft	Resistance lb	Driver's Acceleration Avg. 1/10 Highest g
0	8.0	13.4	13,560	-
	8.5	12.7	12,130	-
	9.0	11.9	11,860	2.10
	10.0	10.5	11,980	2.67
	11.0	9.4	12,560	4.00
2	7.0	12.6	12,330	1.78
	7.5	11.7	11,430	1.95
	8.0	10.8	11,090	2.25
	9.0	9.7	11,390	3.25
	10.0	8.4	11,880	-
4	6.0	11.5	11,670	1.40
	6.5	10.8	11,030	1.94
	7.0	10.1	10,780	2.50
	7.5	9.4	10,700	3.10
	8.0	8.8	10,810	3.75
	9.0	7.7	11,300	-
6	5.0	10.8	12,180	1.50
	5.5	10.1	10,810	2.10
	6.0	9.3	10,180	2.70
	6.5	8.7	10,090	3.35
	7.0	8.0	10,290	4.00
	8.0	6.9	10,840	-

TABLE 2.4

ROUGH WATER RESISTANCE OF MCDEC LVA
AT 55,000 lb DISPLACEMENT

Speed: 35 mph

Flap Deflection degrees	Trim degrees	LCG ft	Resistance lb	Driver's Acceleration Avg. 1/10 Highest g
0	7.5	11.8	10,830	2.58
	8.5	9.8	10,580	4.30
	9.5	8.3	10,980	6.08
2	6.0	12.1	11,290	2.25
	6.5	10.8	10,280	3.13
	7.0	9.6	9,920	4.00
	7.5	8.8	9,950	4.85
	8.0	8.1	10,120	5.75
4	4.8	11.5	11,860	-
	5.0	10.8	10,820	2.77
	5.5	9.4	9,780	3.63
	6.0	8.4	9,280	4.52
	6.5	7.6	9,350	5.40
	7.0	7.0	9,530	6.27
6	4.0	9.6	10,990	3.00
	4.25	9.0	9,710	3.45
	4.5	8.4	9,220	3.88
	5.0	7.5	8,720	4.75
	5.5	7.0	8,840	5.65
	6.0	6.4	9,100	6.50

TABLE 2.5

ROUGH WATER RESISTANCE OF MCDEC LVA
AT 55,000 lb DISPLACEMENT

Low speed data for LCG = 11.5 ft

Speed mph	Trim degrees	Resistance lb
10	1.20	4,660
14	3.60	10,510
18	6.30	13,980

TABLE 3.1

ROUGH WATER ACCELERATIONS, HEAD SEA 2.2 ft SIGNIFICANT HEIGHT
55,000 lb 11.5 ft LCG 2^{o} FLAP DEFLECTION

DRIVER'S STATION

Speed, mph	20	25	30	35
1/3-Octave Center Frequency Hz	RMS Acceleration, m/s^2			
.25		.10	.10	.10
.315		.43	.48	.49
.4		.56	.63	.65
.5		.82	1.06	1.12
.63		1.09	1.47	1.57
.8		1.19	1.64	1.84
1.0		1.05	1.32	1.76
1.25		.94	1.35	1.54
1.6		.82	1.43	1.61
2.0		.66	1.34	1.72
2.5		.45	.96	1.32
3.15		.37	.69	1.18
4.0		.31	.64	1.10
5.0		.26	.52	.92
6.3		.22	.46	.80
8.0		.15	.35	.69
10.0		.10	.22	.45
Total RMS acceleration, g	.186	.259	.410	.511
Average 1/3-highest, acceleration, g	.43	.79	1.37	1.70
Average 1/10-highest, acceleration, g	.63	1.08	1.90	2.48

TABLE 3.2

ROUGH WATER ACCELERATIONS, HEAD SEA 2.2 ft SIGNIFICANT HEIGHT
55,000 lb 11.5 ft LCG 2° FLAP DEFLECTION

FORWARD TROOP COMPARTMENT

Speed, mph	20	25	30	35
1/3-Octave Center Frequency Hz	RMS Acceleration, m/s^2			
.25		.10	.09	.10
.315		.39	.43	.46
.4		.51	.57	.60
.5		.74	.95	1.04
.63		.97	1.32	1.45
.8		1.04	1.45	1.69
1.0		.90	1.15	1.60
1.25		.78	1.15	1.39
1.6		.68	1.22	1.46
2.0		.56	1.15	1.56
2.5		.38	.82	1.20
3.15		.30	.59	1.10
4.0		.27	.56	1.04
5.0		.22	.46	.88
6.3		.19	.41	.77
8.0		.14	.32	.69
10.0		.10	.22	.48
Total RMS acceleration, g	.154	.227	.364	.478
Average 1/3-highest acceleration, g	.37	.69	1.21	1.63
Average 1/10-highest acceleration, g	.50	.95	1.73	2.42

TABLE 3.3

ROUGH WATER ACCELERATIONS, HEAD SEA 2.2 ft SIGNIFICANT HEIGHT
55,000 lb 11.5 ft LCG 2° FLAP DEFLECTION

CENTER OF GRAVITY

Speed, mph	20	25	30	35
1/3-Octave Center Frequency Hz	RMS Acceleration, m/s^2			
.25		.09	.08	.08
.315		.33	.37	.38
.4		.43	.48	.50
.5		.62	.79	.85
.63		.80	1.08	1.18
.8		.83	1.18	1.36
1.0		.70	.92	1.24
1.25		.62	.90	1.04
1.6		.44	.83	.98
2.0		.27	.68	.97
2.5		.21	.52	.82
3.15		.17	.39	.78
4.0		.15	.38	.76
5.0		.12	.30	.68
6.3		.13	.29	.60
8.0		.08	.23	.56
10.0		.09	.18	.41
Total RMS acceleration, g	.121	.173	.274	.353
Average 1/3-highest acceleration, g	.28	.44	.81	1.13
Average 1/10-highest acceleration, g	.34	.61	1.21	1.78
Average 1/3-highest double amplitude:				
Pitch, degrees	4.8	4.7	5.6	6.4
Heave, ft	1.2	1.4	1.6	1.9

TABLE 3.4

ROUGH WATER ACCELERATIONS, HEAD SEA 2.2 ft SIGNIFICANT HEIGHT
55,000 lb 11.5 ft LCG 2° DLAP DEFLECTION

AFT TROOP COMPARTMENT

Speed, mph	20	25	30	35
1/3-Octave Center Frequency Hz	RMS Acceleration, m/s^2			
.25		.08	.08	.06
.315		.28	.30	.31
.4		.36	.39	.40
.5		.50	.62	.66
.63		.64	.84	.91
.8		.63	.86	.98
1.0		.46	.59	.72
1.25		.32	.48	.50
1.6		.21	.37	.48
2.0		.16	.21	.46
2.5		.09	.15	.42
3.15		.08	.16	.44
4.0		.07	.11	.41
5.0		.06	.08	.39
6.3		.11	.12	.36
8.0		.04	.05	.31
10.0		-	.04	.19
Total RMS acceleration, g	.092	.120	.162	.213
Average 1/3-highest acceleration, g	.23	.29	.34	.57
Average 1/10-highest acceleration, g	.29	.36	.46	.92

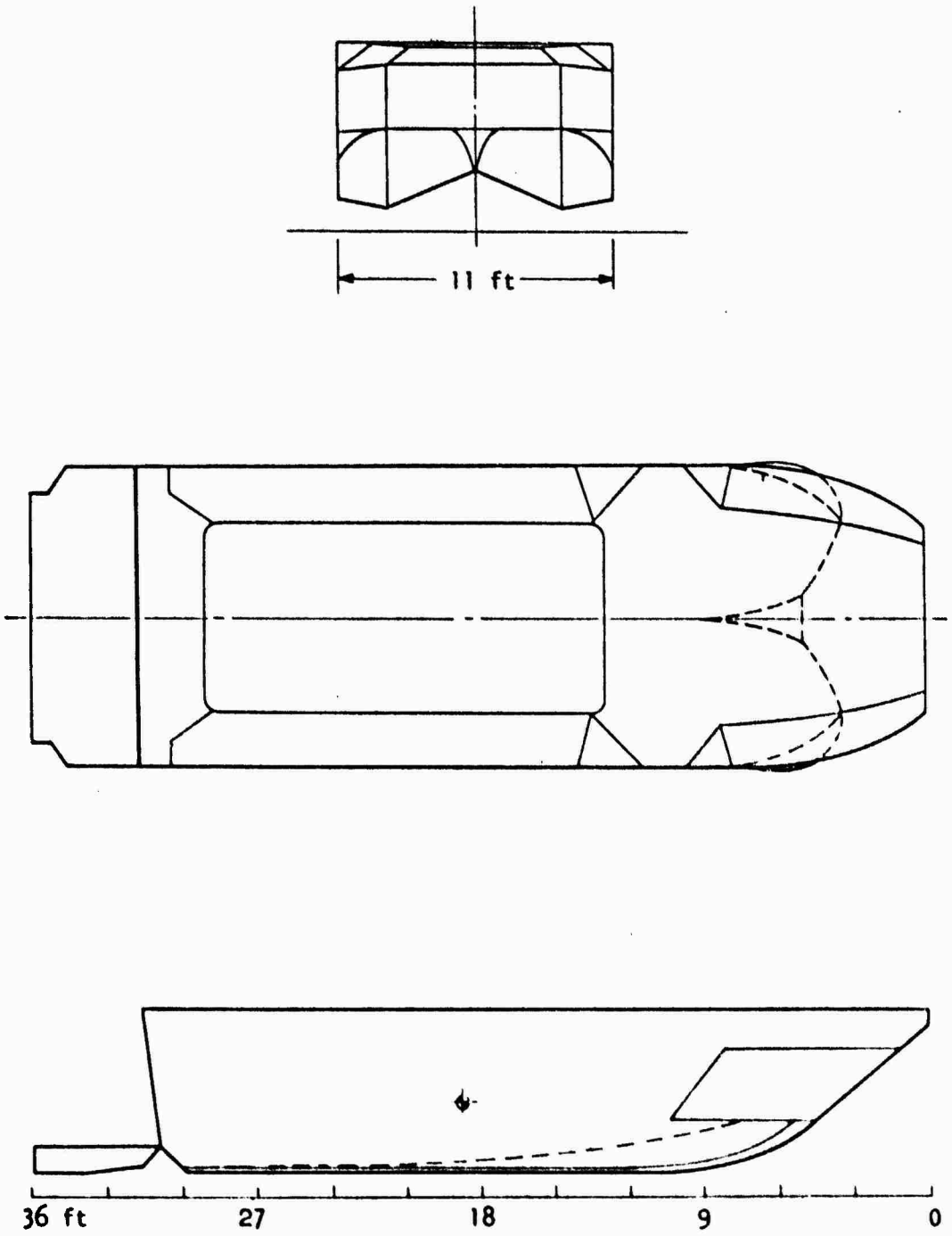


FIGURE 1 MCDEC LVA HULL LINES

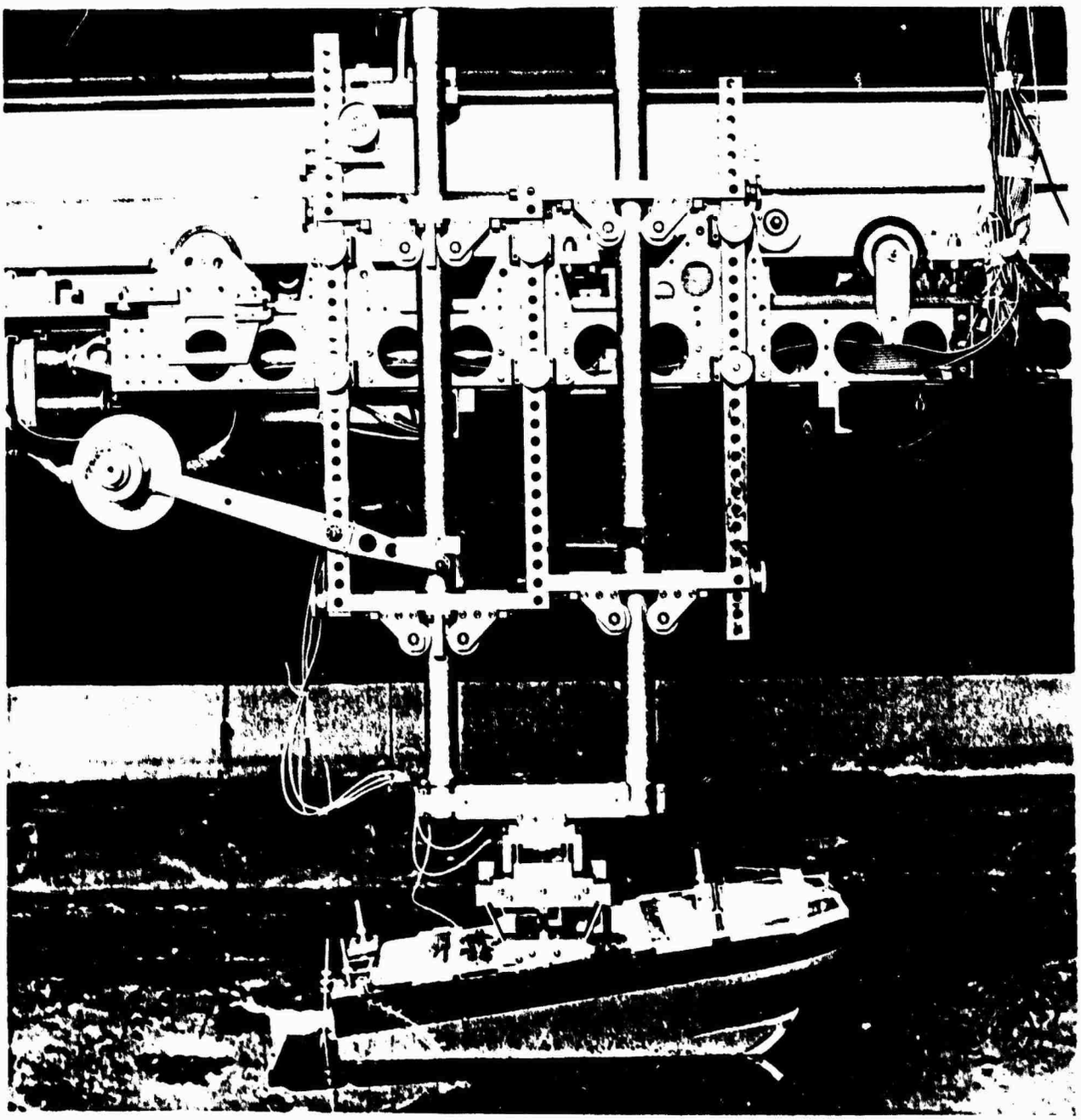


FIGURE 2 MCDEC MODEL SET UP FOR
CALM WATER FIXED TRIM TESTS

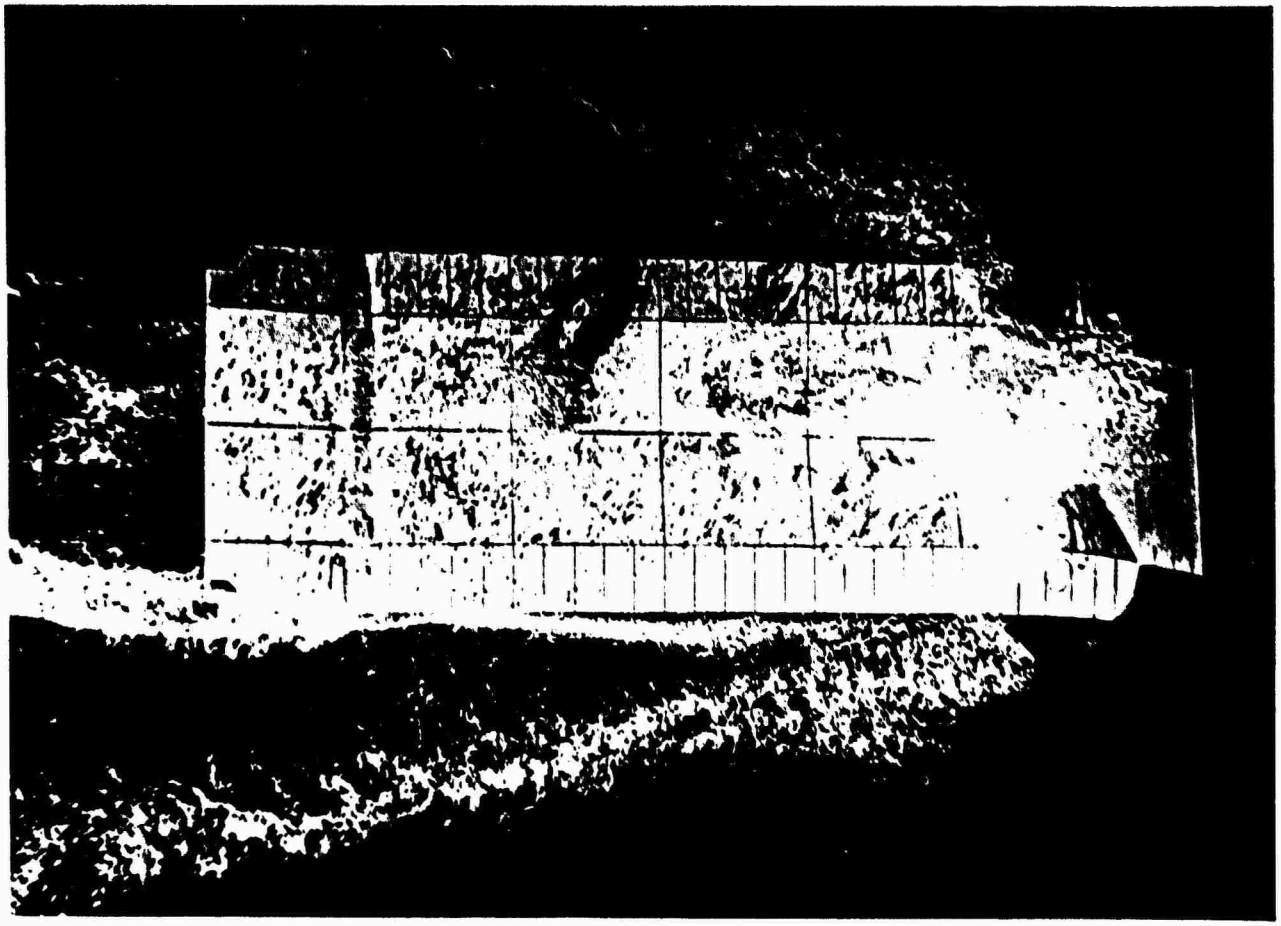


FIGURE 3 UNDERWATER PICTURE AT 20 mph, 44,375 lb, 6° TRIM, IN CALM WATER

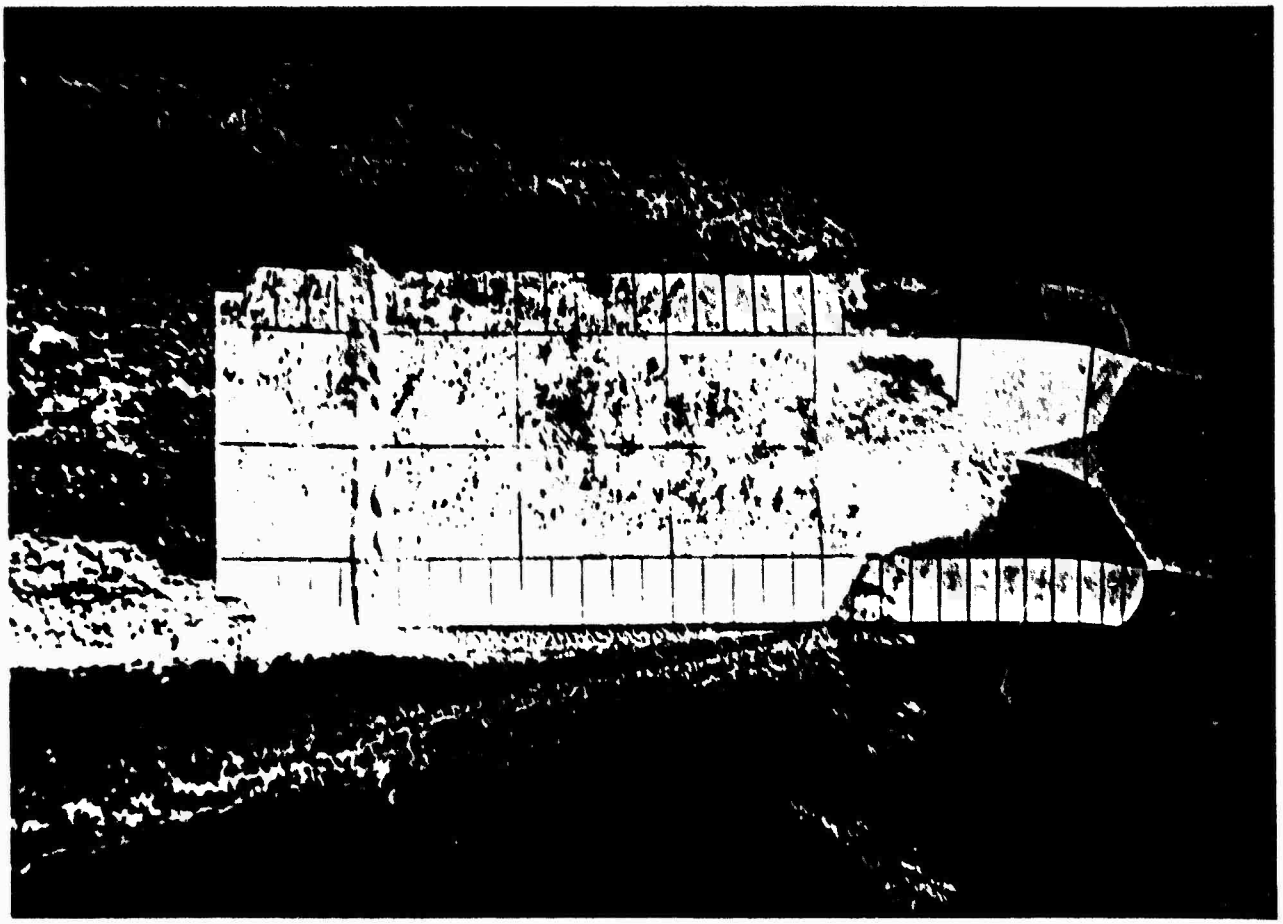


FIGURE 4 UNDERWATER PICTURE AT 25 mph,
44,375 lb, 8° TRIM, IN CALM WATER

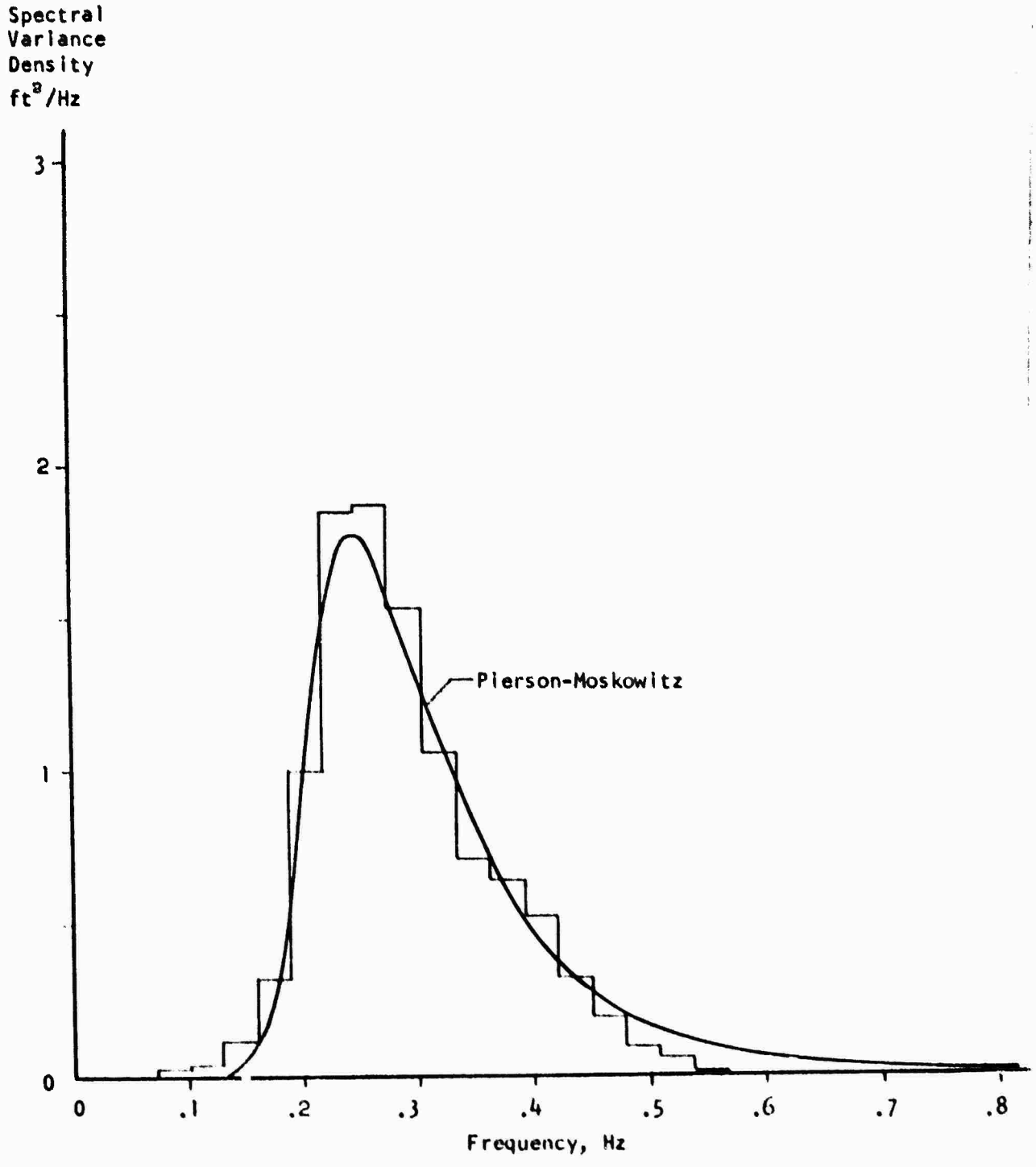


FIGURE 5 EXPERIMENTAL WAVE SPECTRUM
SIGNIFICANT HEIGHT 2.2 FT

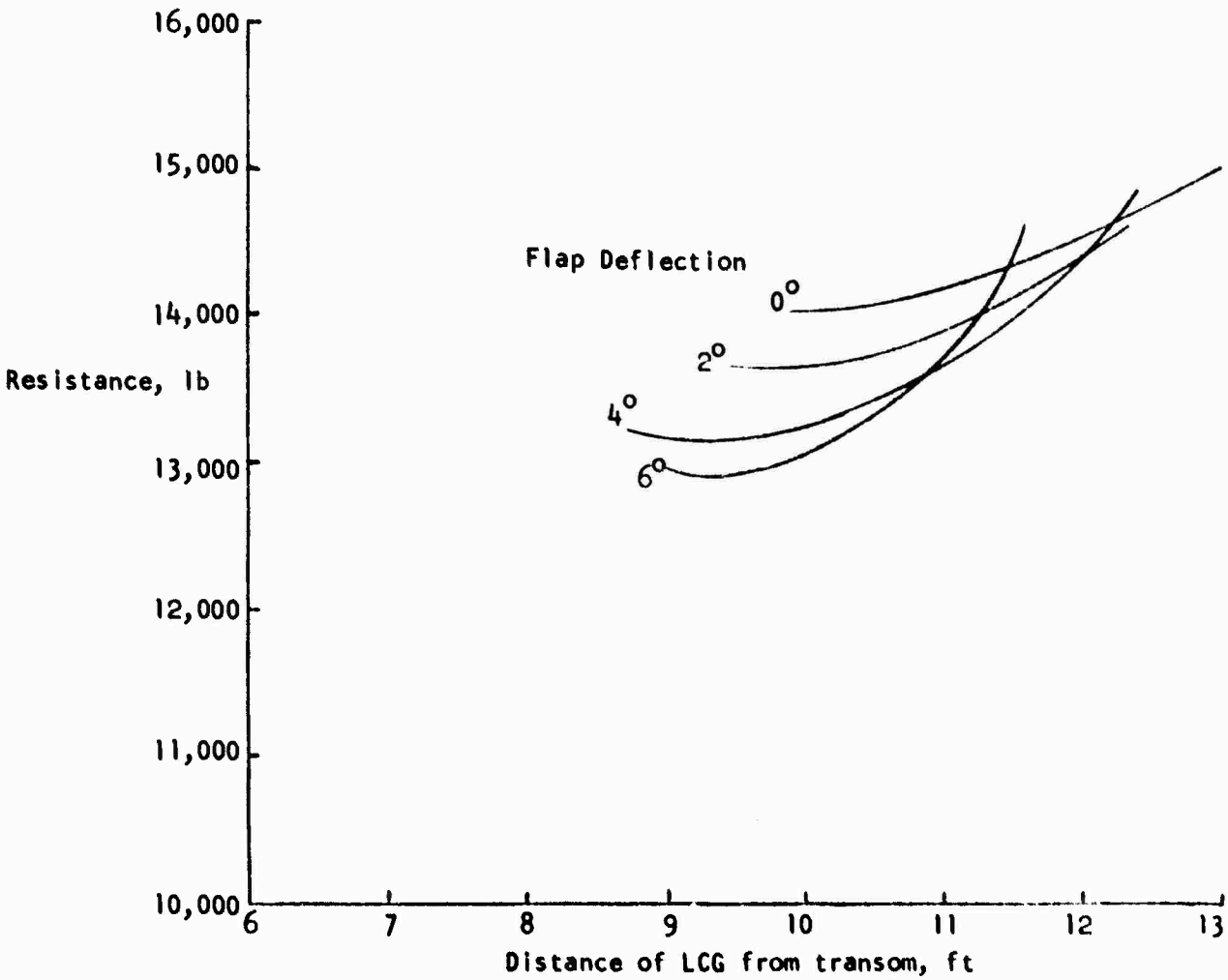
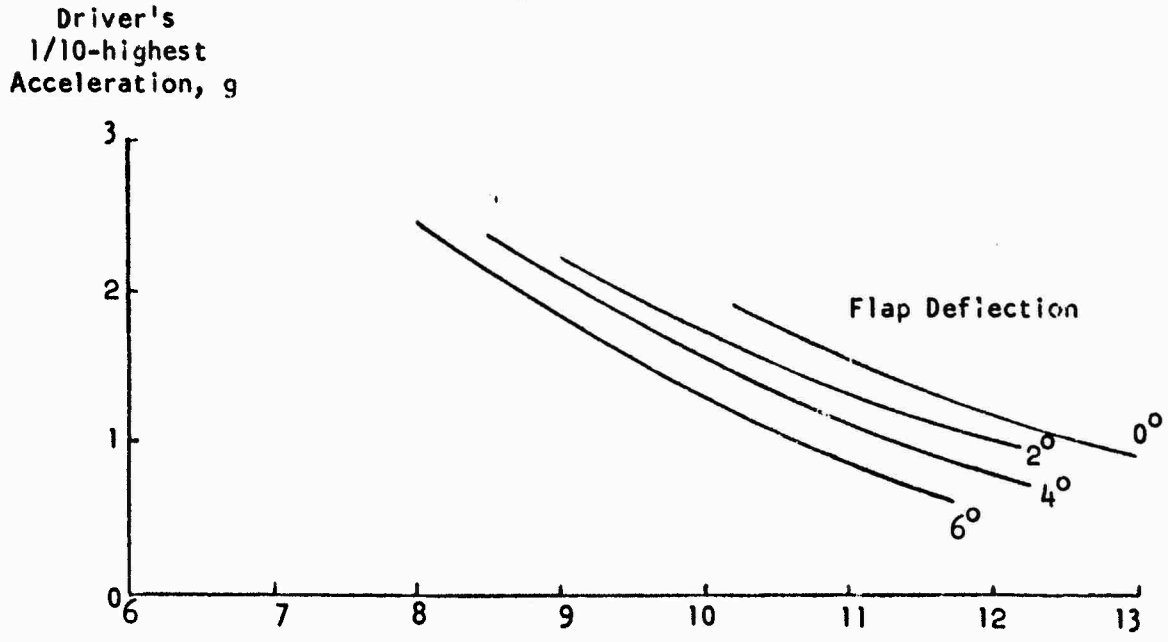


FIGURE 6 SEA STATE 2 (2.2 FT SIGNIFICANT HEIGHT) RESISTANCE CHARACTERISTICS AT 20 mph, 55,000 lb GROSS WEIGHT



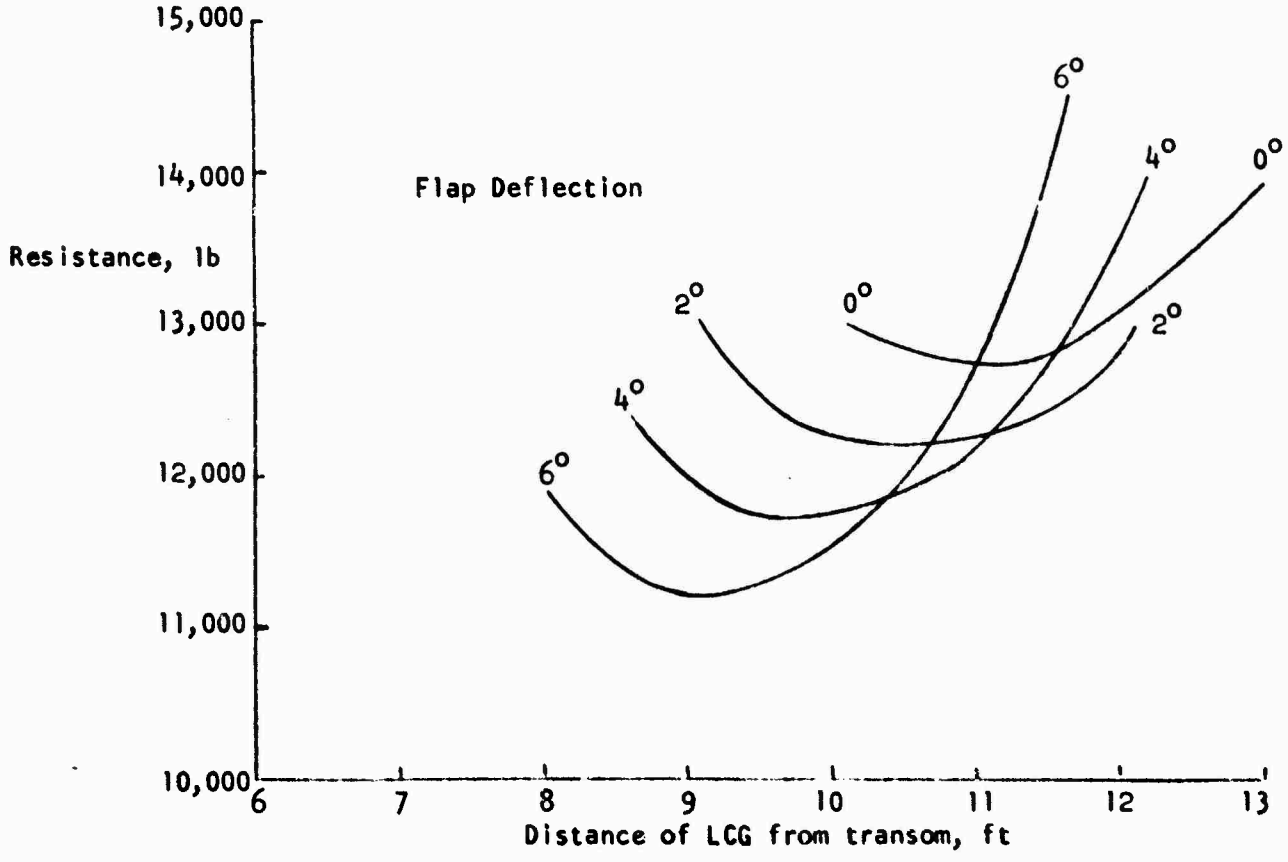


FIGURE 7 SEA STATE 2 ACCELERATION AND RESISTANCE CHARACTERISTICS AT 25 mph, 55,000 lb

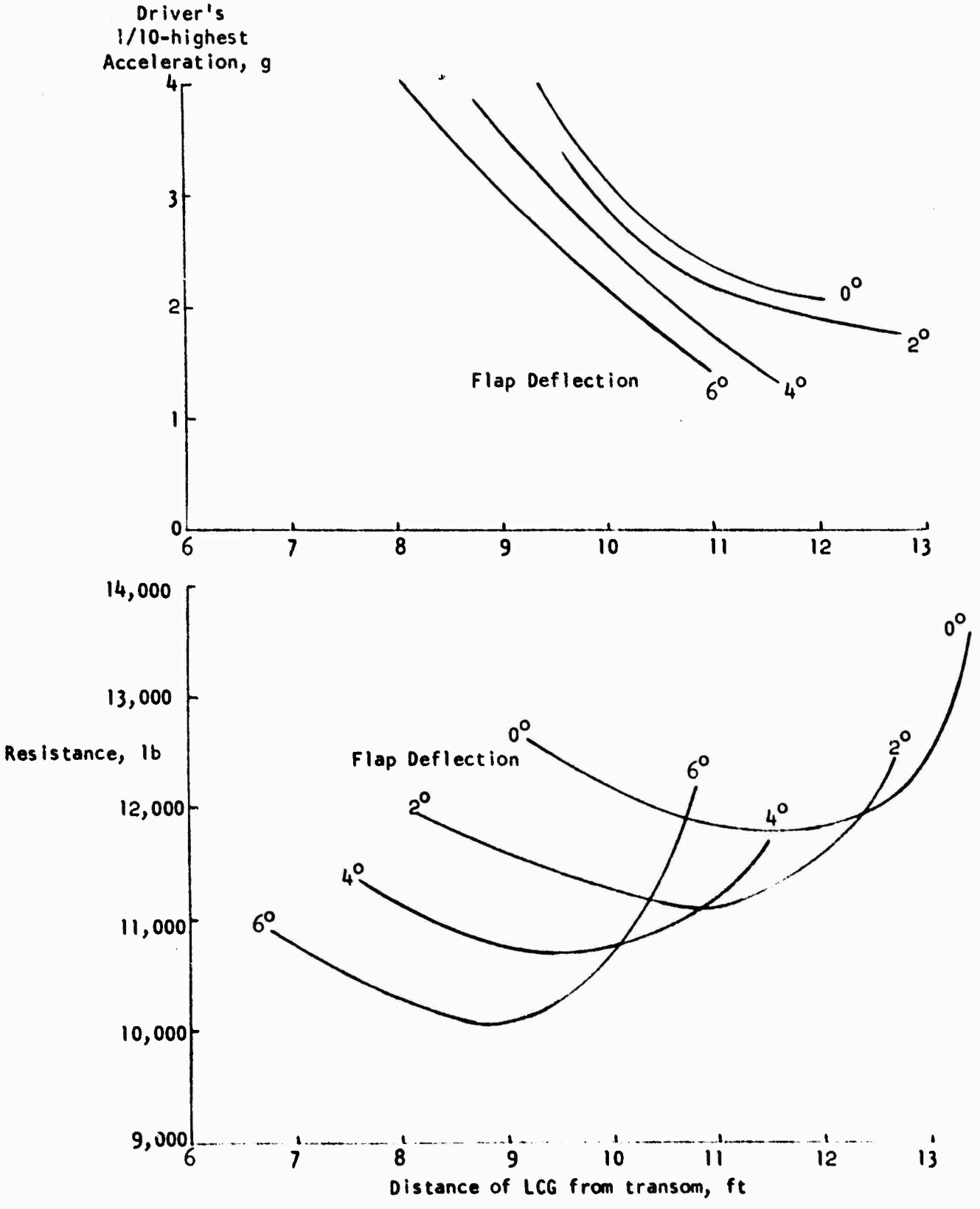


FIGURE 8 SEA STATE 2 ACCELERATION AND RESISTANCE CHARACTERISTICS AT 30 mph, 55,000 lb

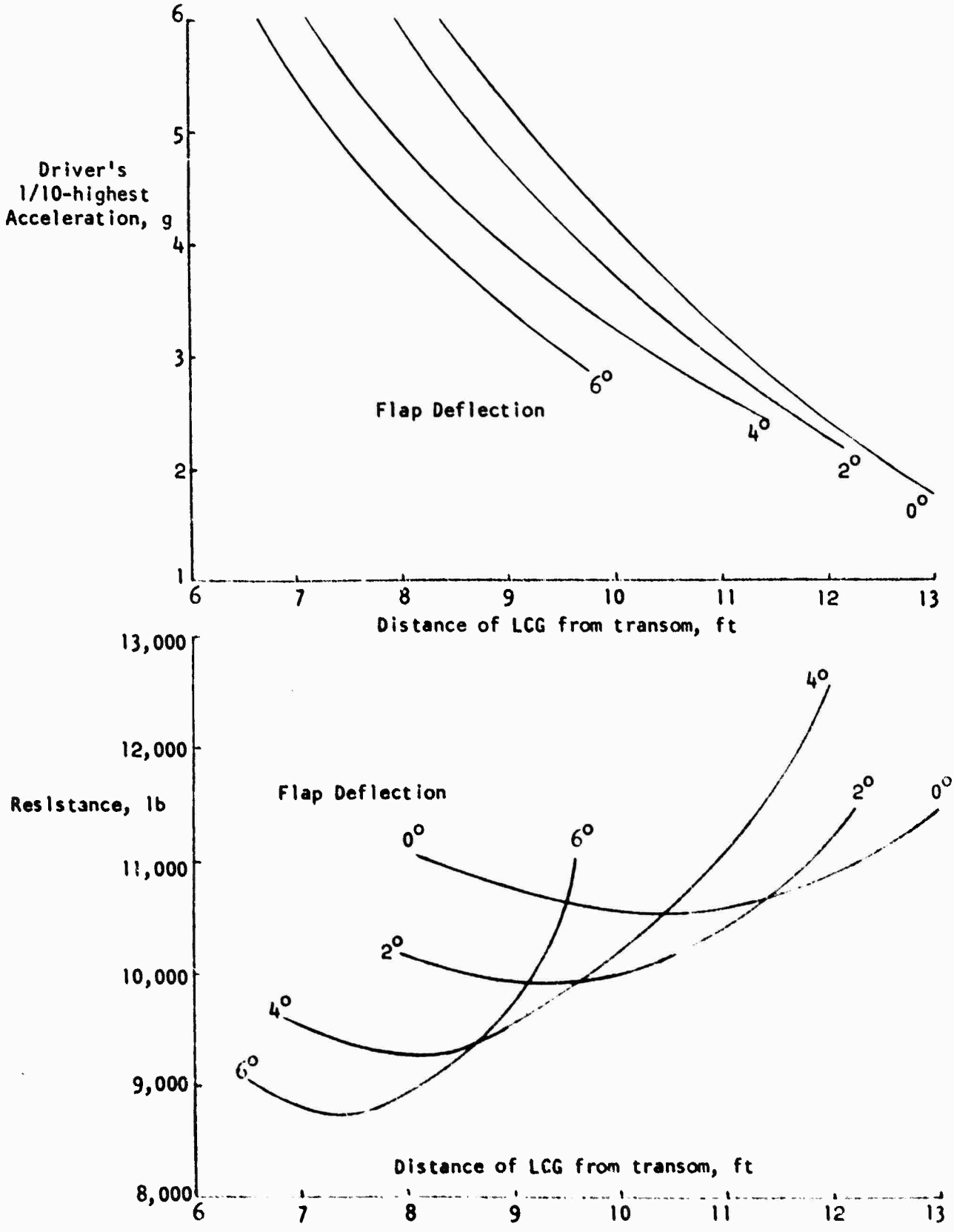


FIGURE 9 SEA STATE 2 ACCELERATION AND RESISTANCE CHARACTERISTICS AT 35 mph, 55,000 lb

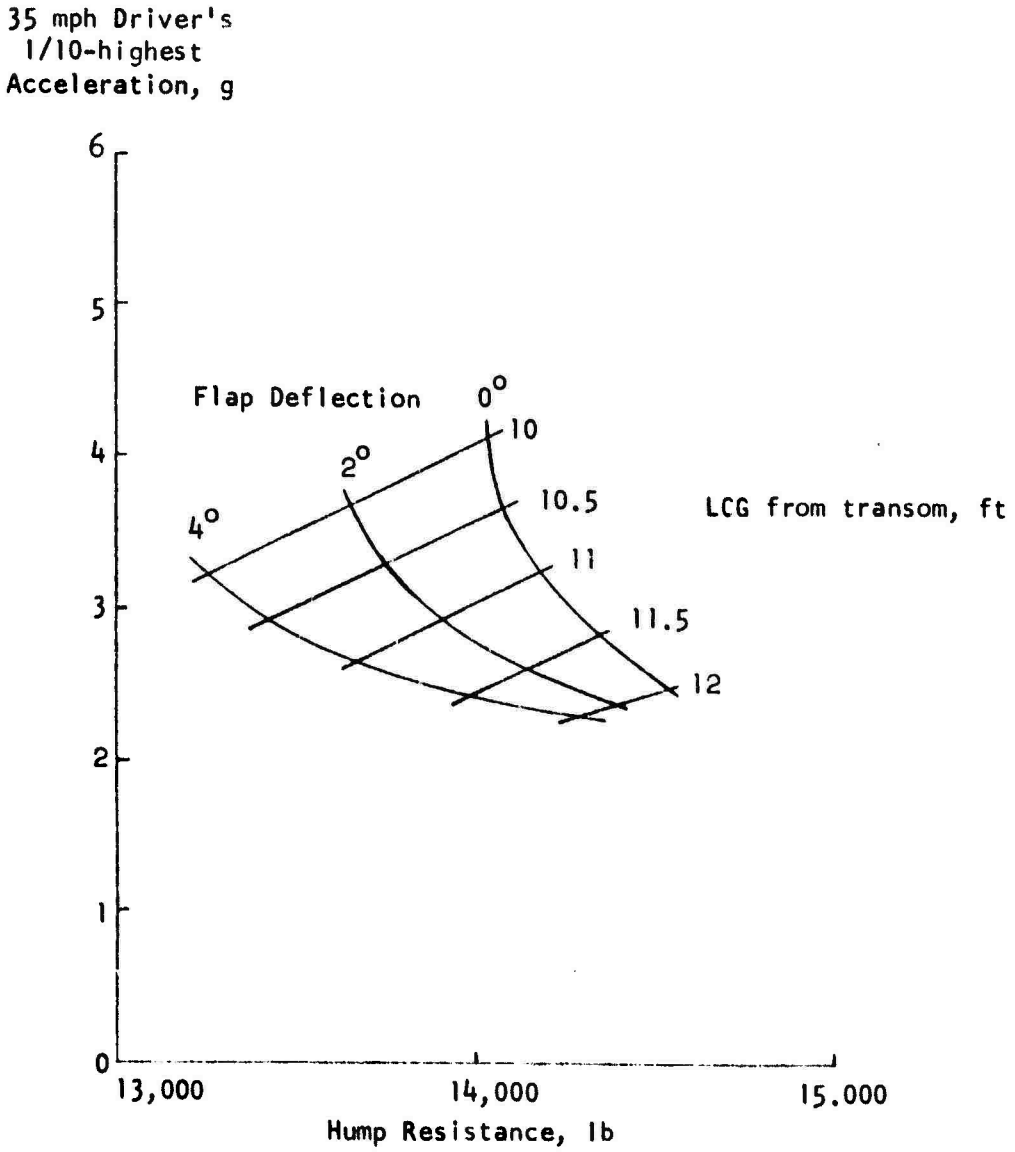


FIGURE 10 OPTIMIZATION PLOT OF HIGH SPEED ACCELERATION VERSUS HUMP RESISTANCE

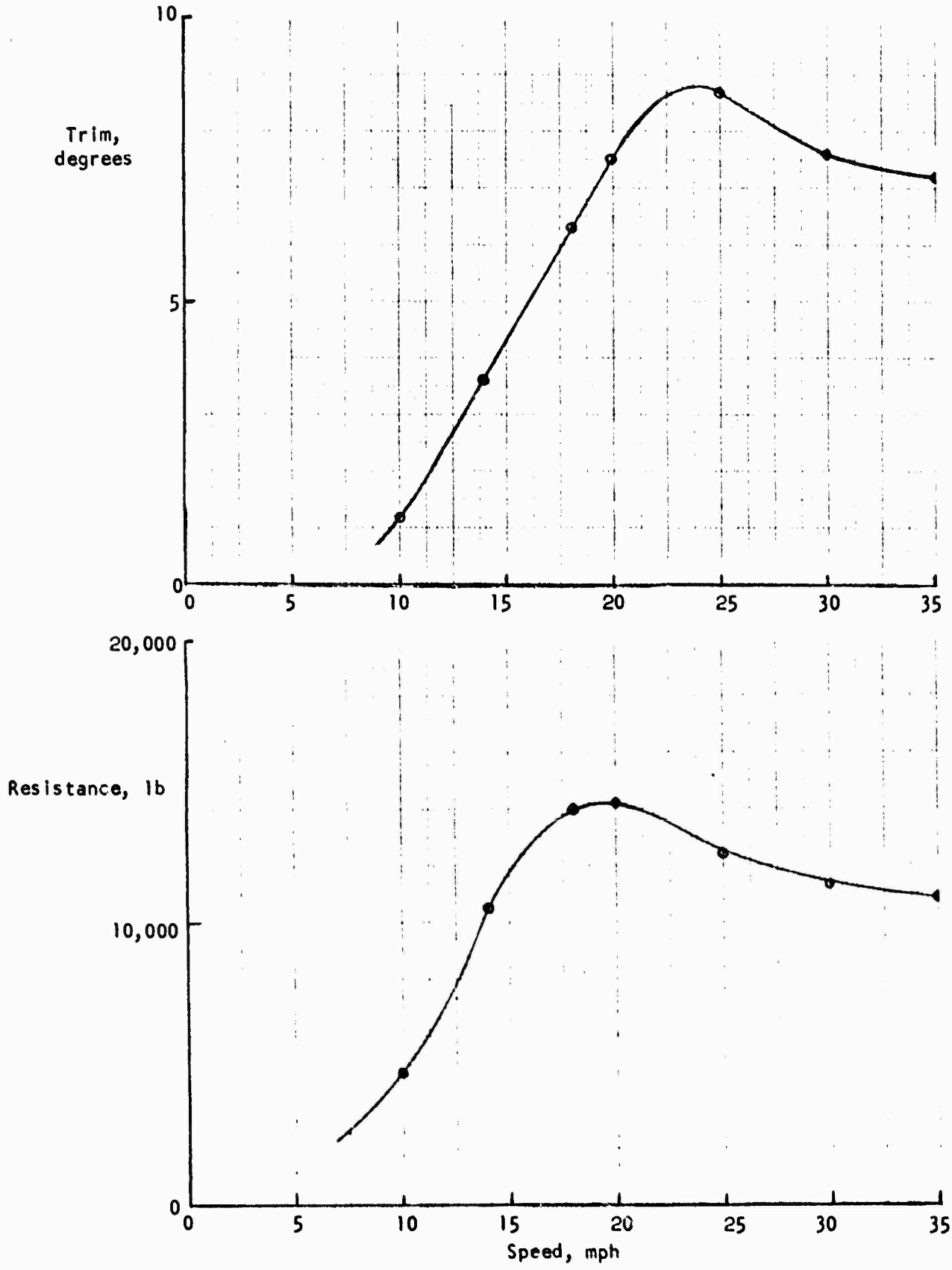


FIGURE 11 RESISTANCE AND TRIM AT 55,000 lb, 11.5 ft LCG, 2° FLAP ANGLE IN SEA STATE 2

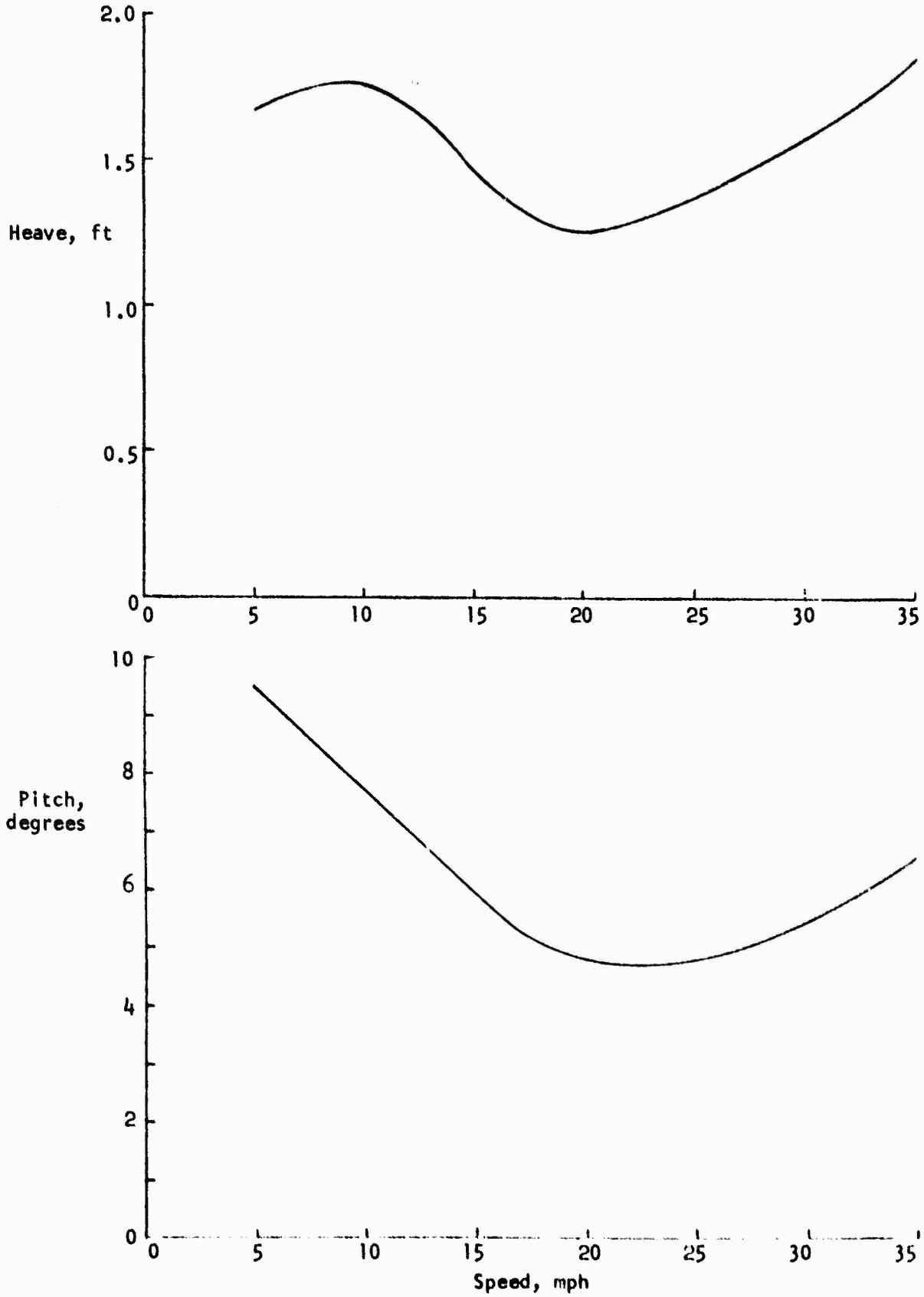


FIGURE 12 SIGNIFICANT MOTION DOUBLE AMPLITUDES AT 55,000 lb, 11.5 ft LCG, 2° FLAP, SEA STATE 2

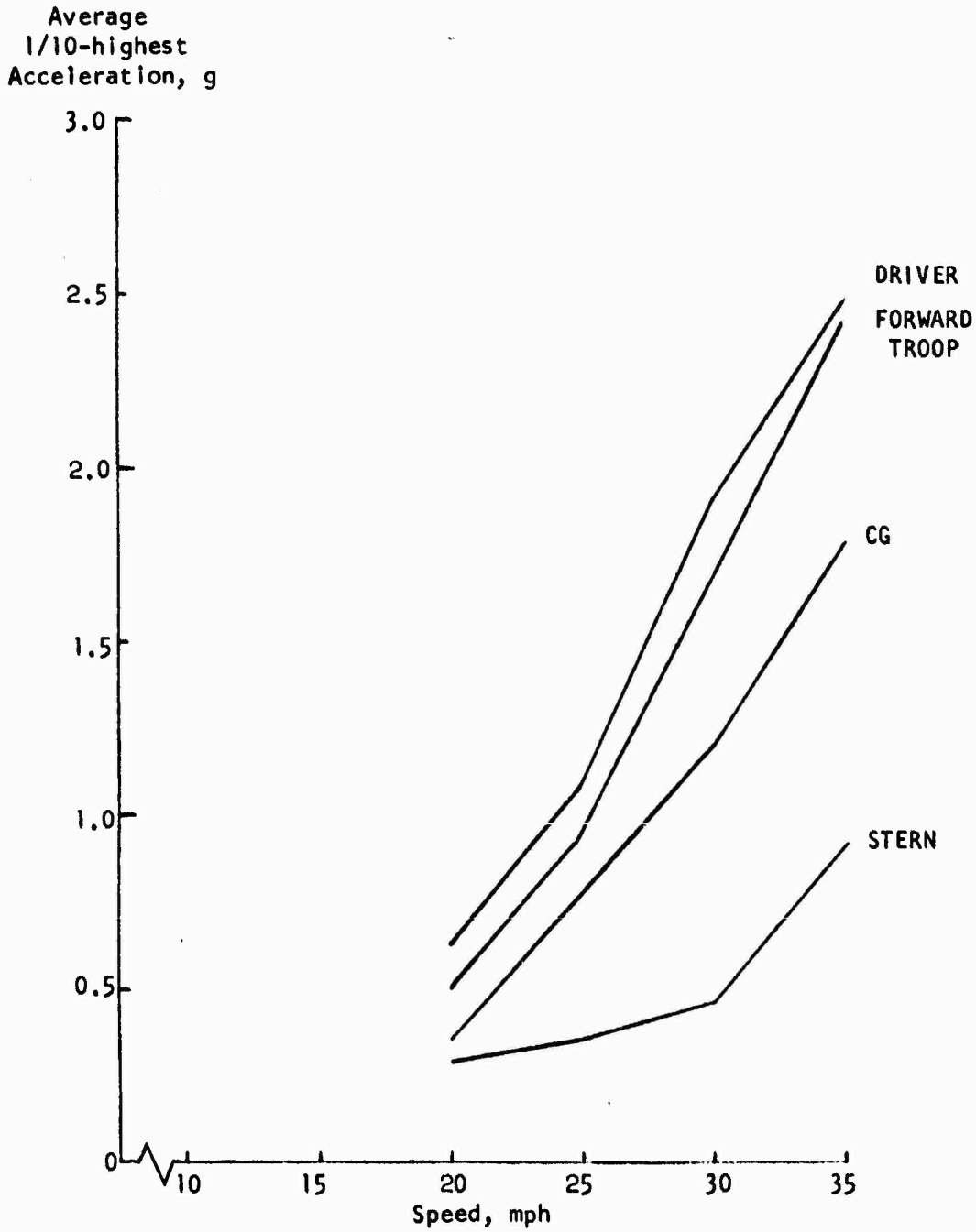


FIGURE 13 VARIATION OF ACCELERATION WITH SPEED FOR FOUR LOCATIONS AT 55,000 lb, 11.5 ft LCG, 2^{o} FLAP ANGLE IN SEA STATE 2

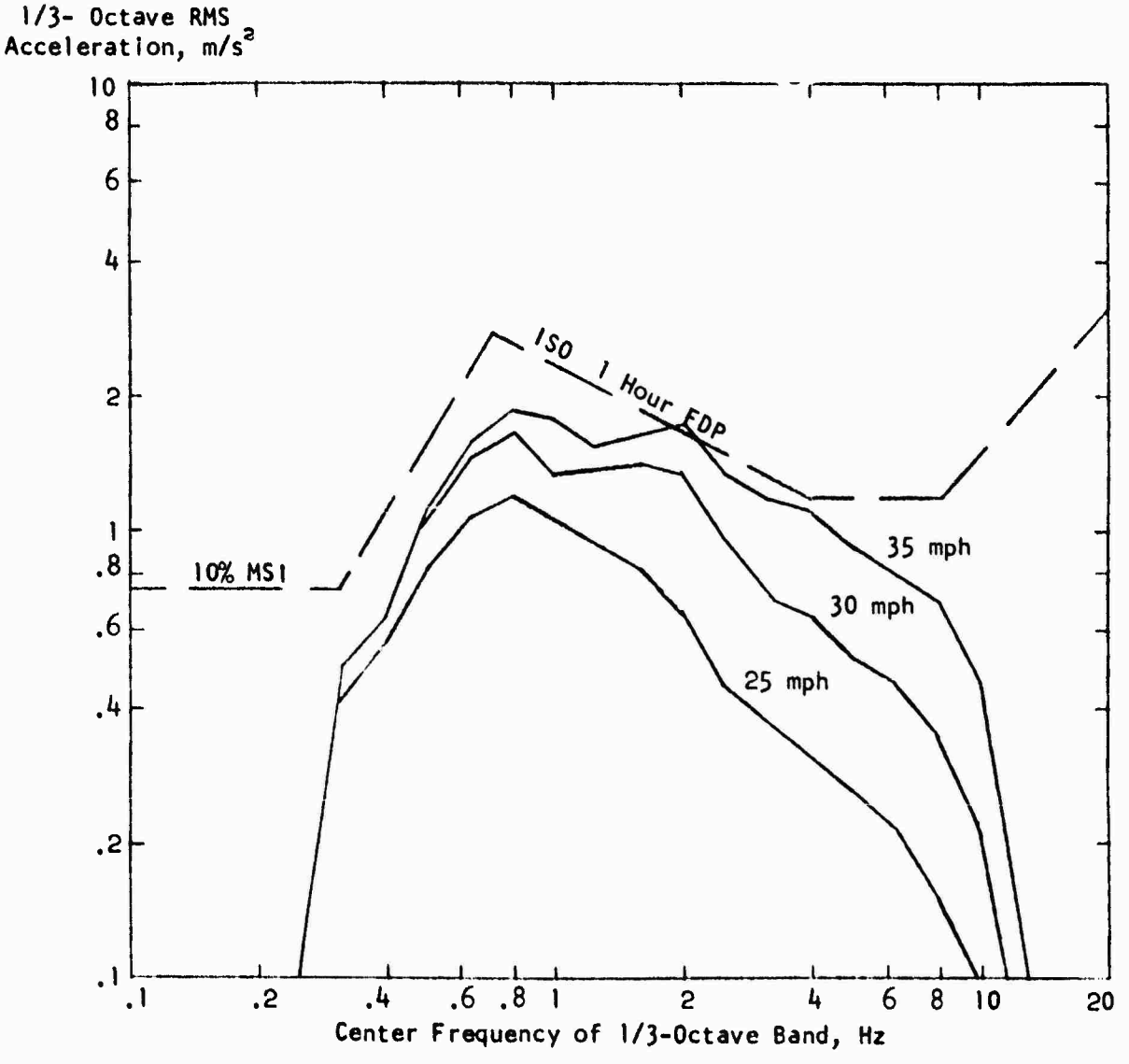


FIGURE 14 DRIVER'S RIDE QUALITY AT 55,000 lb
11.5 ft LCG, 2^{o} FLAP IN SEA STATE 2

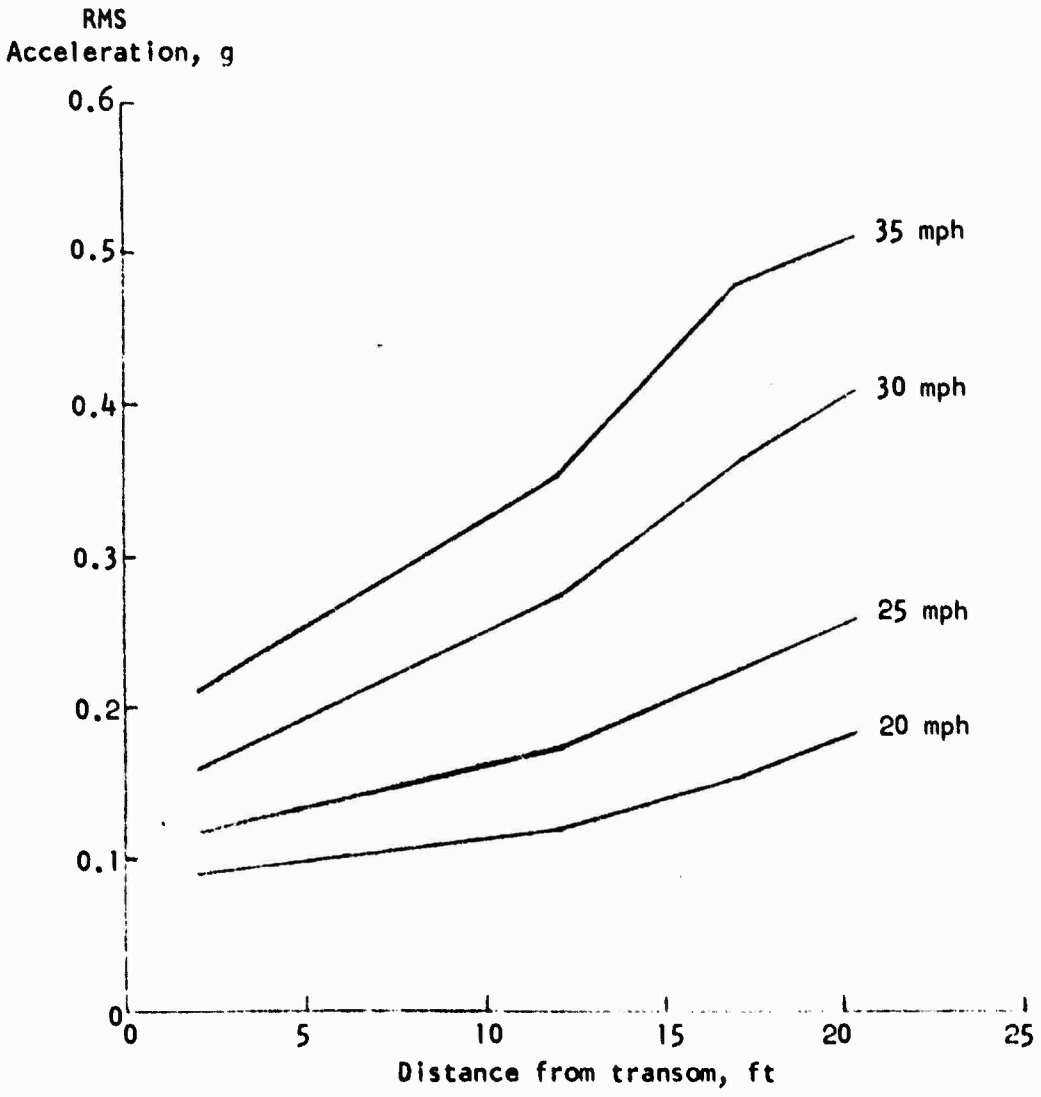


FIGURE 15 VARIATION OF ACCELERATION WITH POSITION AT 55,000 lb, 11.5 ft LCG, 2° FLAP IN SEA STATE 2

APPENDIX A

MODEL RESULTS, ANALYSIS AND FULL-SCALE PERFORMANCE PREDICTION

Tables of the model results and the methods used to expand them to full-scale are presented in this Appendix. The method of expansion differs in two respects from that described in previous reports in the LVA series[3]: A new method of expanding the rough water resistance of planing craft is introduced which avoids the need to identify the added resistance in waves, and the expansions are carried out at a series of constant trims where the forces and moments on the craft are brought to equilibrium at each trim, thus in effect covering a range of CG positions and flap deflections.

RESULTS

The fixed trim calm water model results are presented in Tables A1.1 to A1.4 for speeds corresponding to ship speeds of 20, 25, 30 and 35 mph. The entries in the tables include: the run number, the speed; the deflection of the transom flap; the lift or load-on-water; the trim; the drag, the position of the center of pressure (CP), from the trailing edge of the transom flap which is 4.92 inches aft of the transom, see page 4 of the main text; the dynamic keel wetted length (WL) from the flap trailing edge, determined from underwater photographs; the static keel wetted length, see page 5 of the main text; the parasite drag (D - Ltanτ = R - DTANT); the running draft relative to the still water surface at the center of moments (CM); and the pitching moment on the hull, positive bow-up, about the CM.

The rough water model results at a displacement corresponding to a gross weight of 55,000 lb are given in Tables A2.1 to A2.5. Low speed results covering a range of ship speeds from 5 to 17 mph are given in Table A2.1. The results for ship speeds of 20, 25, 30 and 35 mph are

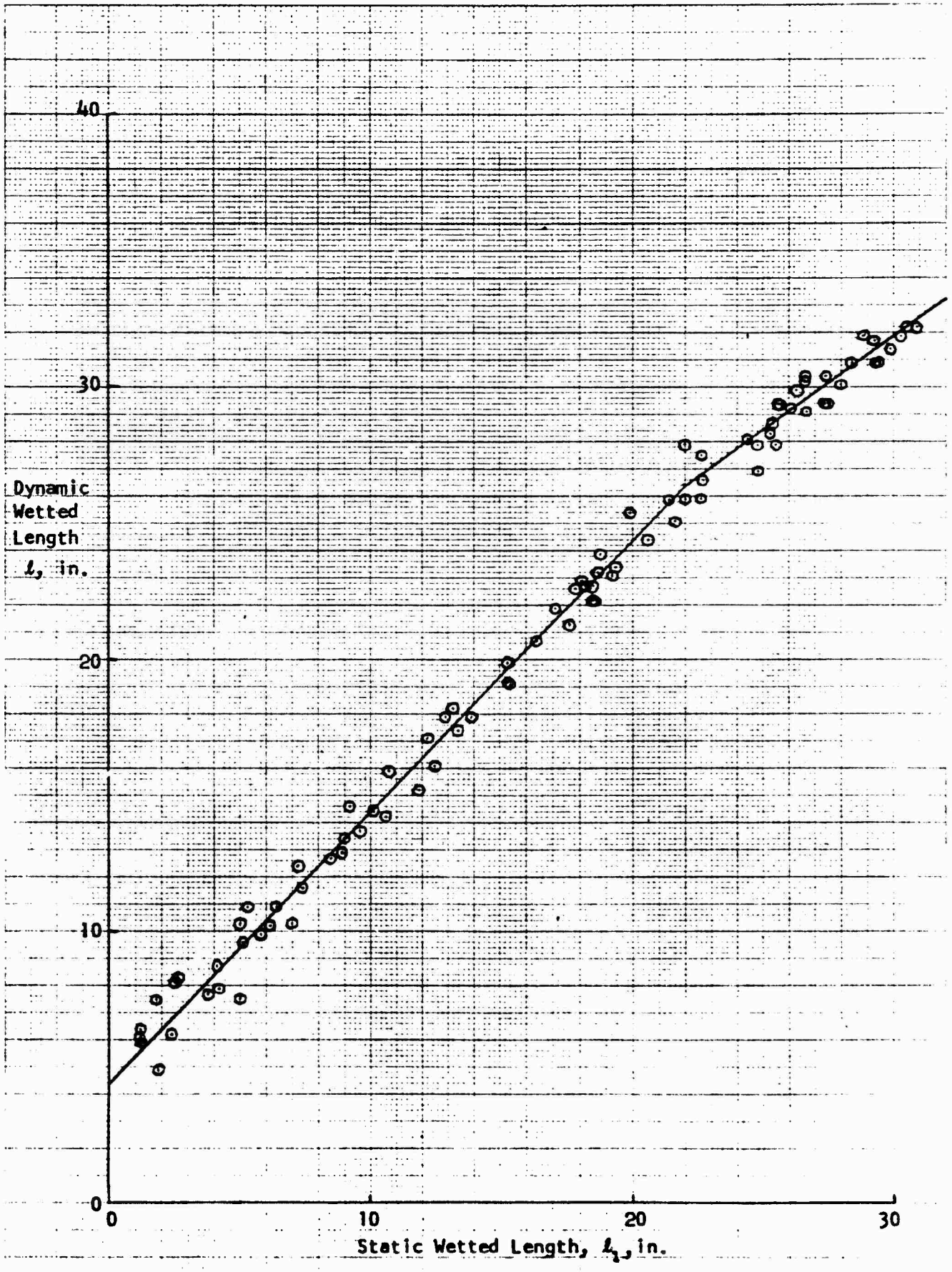


FIGURE A1 WETTED LENGTH CHARACTERISTICS

contained in Tables A2.2 to A2.5. For a gross weight of 60,000 lb the results are given in Table A2.6. The rough water results are presented one run to a page. The three-line heading includes: the load-on-water, position of the LCG relative to the transom and flap deflection; the speed, drag, center of pressure (CP) and static keel wetted length (SKWL) as defined above; the significant wave height and number of waves encountered. This is followed by the statistics of the motions and accelerations. Each data channel has a two-line entry including: mean/rms; number of oscillations; average of all the peaks/average of all the troughs and similarly for the 1/3 and 1/10 highest oscillations, and the extreme peak/extreme trough. The Froude scaled data entry shows the corresponding ship speed and the results of multiplying the model drag by the displacement ratio $\Delta_s/\Delta_m = 1775$, this approximation ignores the effects of thrust unloading, thrust pitching moment and Reynolds Number.

DATA ANALYSIS

It would be convenient if the rough water model data could be expanded to full-scale on a run by run basis, but such is not the case. To see why this is not so consider Run 92 in Table A2.5. The model and corresponding full-scale data for this run are compared in the following table:

	1/12-Scale Model	Ship
Speed	14.86 fps	35.1 mph
Load on water, lb	31.0	55,025
Trim, degrees	6.12	6.12
Wetted length	26 0 in.	26.0 ft
Drag, lb	7.28	11,765
Gross weight, lb	31.0	56,704
LCG forward of transom	12.08 in.	12.52 ft

It is obvious that this run corresponds to a gross weight of 56,700 lb at an LCG of 12.52 ft rather than the desired values of 55,000 lb at an LCG of 12.08 ft. The increase in weight is due to the fact that the

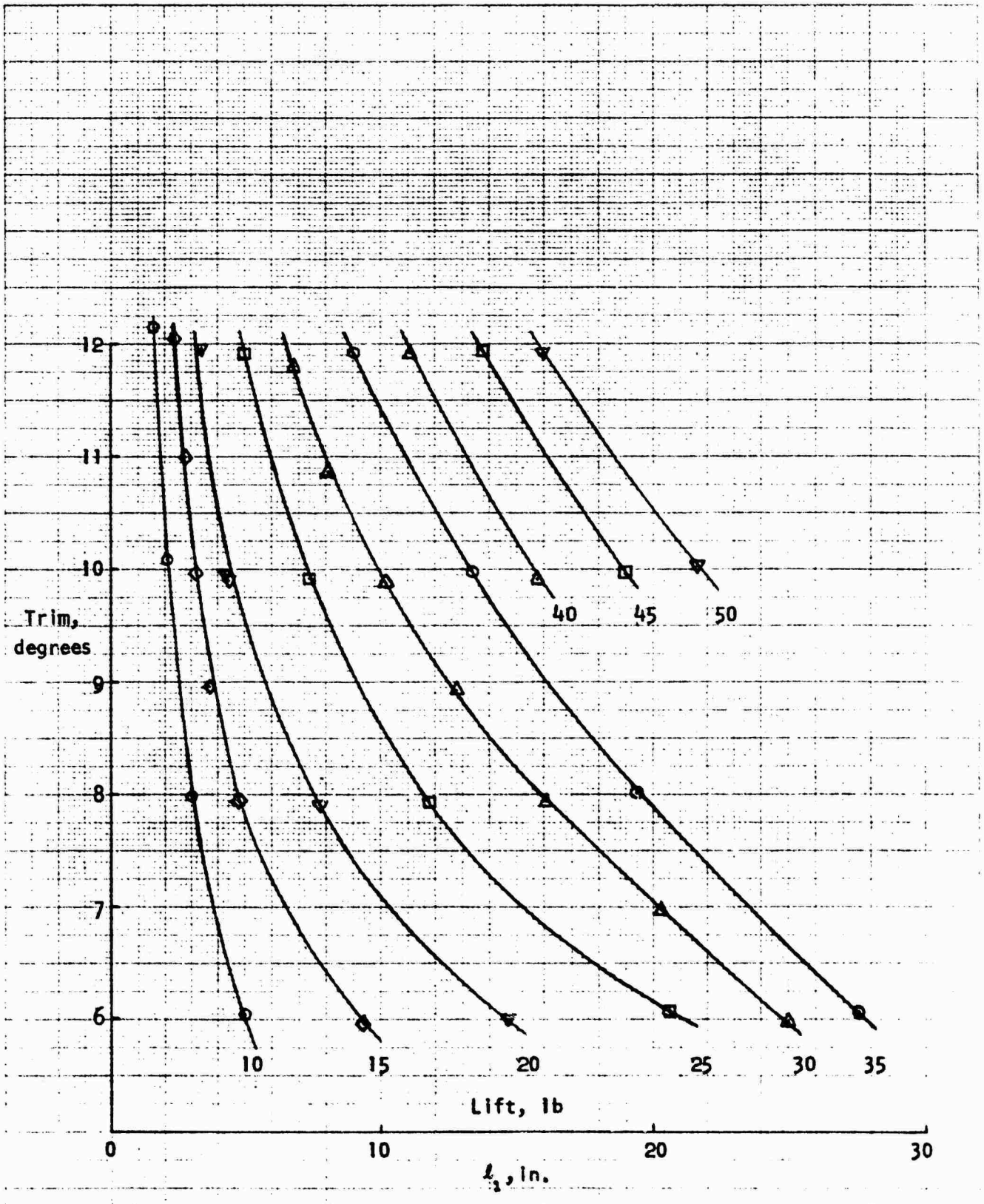


FIGURE A2 MODEL LIFT CHARACTERISTICS AT 14.82 FPS (35 mph)

gross weight is the sum of the load-on-water and the vertical component of thrust. The effect of the thrust component cannot be allowed for during the rough water tests since it is necessary to preserve the proper value of mass in vertical oscillation to obtain the correct acceleration. The forward shift in the LCG is due to the excess moment applied by the horizontal towing force in the model tests compared to the moment provided by the full-scale thrust vector which is parallel to the transom flap.

Consequently to obtain the rough water drag at a constant value of gross weight it is first necessary to analyze the model data. The functional relationships that will be needed are discussed in the following sections and then used to synthesize the drag. The fundamental planing quantities are the trim and dynamic wetted length, and it is appropriate to begin with a discussion of the wetted length.

Dynamic Wetted Length

As has been noted previously[3] it is well established for planing surfaces in calm water that, at any given trim and speed, the lift, drag and center of pressure are unique functions of the wetted length. It will be argued here that the same applies in rough water to the mean values of lift, drag and center of pressure. The dynamic wetted length can only be measured in calm water, however the static keel wetted length (SKWL, see page 5 of the main text) can be determined in both calm and rough water. Hence a relationship between the dynamic wetted length and the SKWL may be obtained from the calm water tests which is assumed to apply to both calm and rough water. This assumption is subsequently justified.

The dynamic wetted length used in this report is the keel wetted length. For example, Figure 4 is an underwater picture taken during calm water Run No. 89 and the mean keel wetted length was estimated to be 21.3 in. from the end of the transom flap, cf Table A1.2. The dynamic wetted length is shown plotted as a function of the static length on Figure A1 for all loads, speeds and trims. The required relationships are:

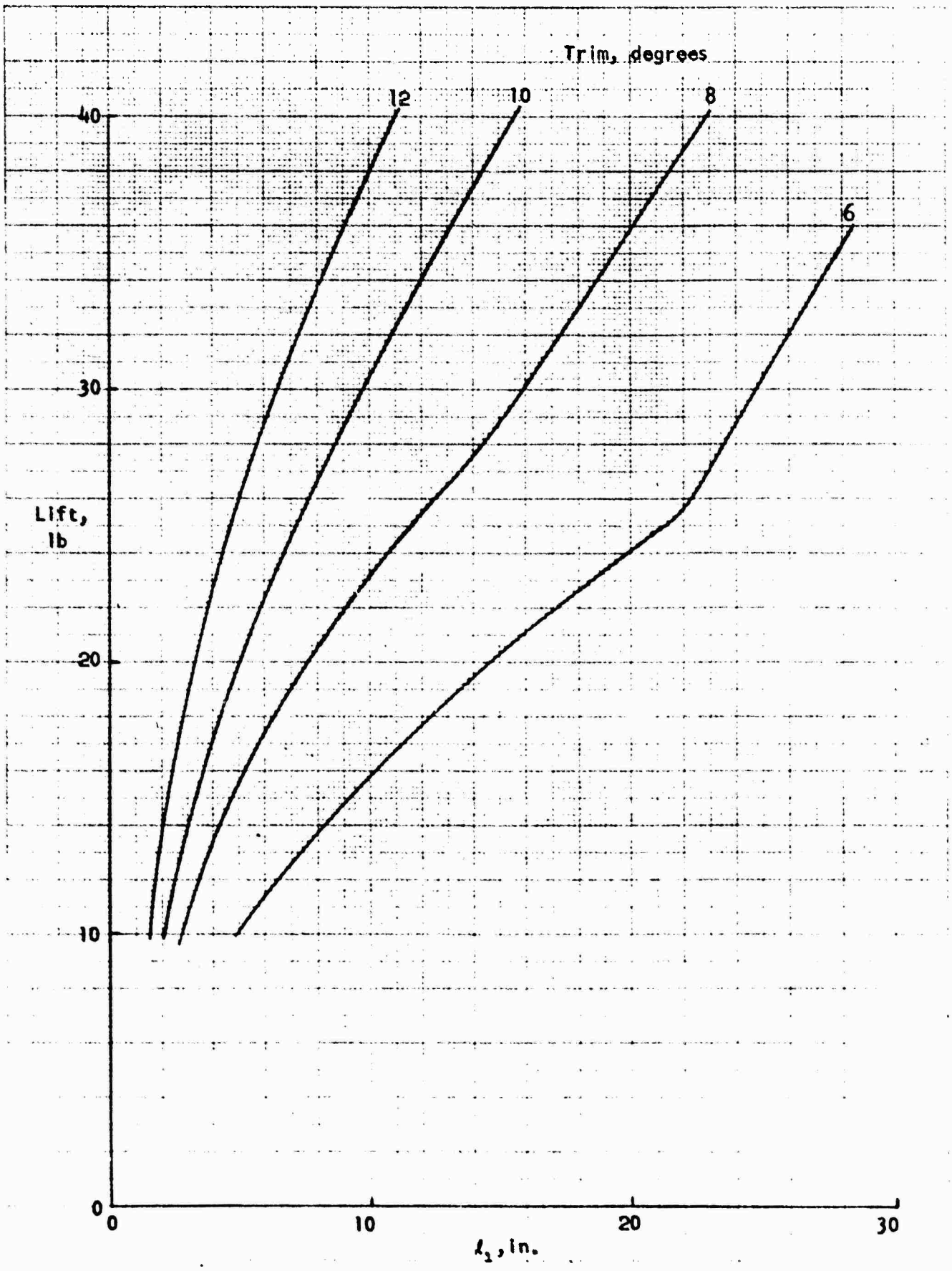


FIGURE A3 MODEL LIFT CHARACTERISTICS AT 14.82 FPS

$$\ell = \ell_1 + 4.42 \qquad \ell_1 \leq 22 \qquad \text{(A1)}$$

$$\ell = .686\ell_1 + 11.24 \qquad \ell_1 > 22 \qquad \text{(A2)}$$

where ℓ = dynamic keel wetted length, in.

ℓ_1 = static keel wetted length, in.

These relationships are independent of speed and trim over the ranges 8 to 15 fps and 6 to 12 degrees.

Because of these relationships ℓ and ℓ_1 may be used interchangeably and it is generally more convenient to work with ℓ_1 . The actual wetted length ℓ will be used in the determination of Reynolds Number and wetted area.

Lift in Calm and Rough Water

At any given speed the lift of a planing craft is a function of the trim and wetted length. This is illustrated for a speed of 14.82 fps on Figure A2 where contours of constant lift are shown on a grid of trim versus SKWL; this plot includes all the zero flap deflection data in Table A1.4. This data was collected over a wide range of wetted length in the (unrealized) hope of automating the expansion process. This data may be cross plotted to obtain curves of lift as a function of wetted length at constant trim as has been done on Figure A3.

The rough water tests were carried out at a load-on-water (lift) of 31 lb and a curve of trim against wetted length at 14.82 fps for a lift of 31 lb, from the calm water curves of Figure A3, is shown on Figure A4. Also shown on this plot is the zero flap rough water data from Table A2.5 (Runs 104,94,87 and 91). This agreement between the calm water and rough water lift characteristics is considered to be very satisfactory, especially in view of the fact that in rough water the model was pitching and heaving ± 5 degrees and ± 1.5 in.

On the basis of this and similar comparisons at other speeds, it is concluded that the lift characteristics are identical for both calm and rough water.

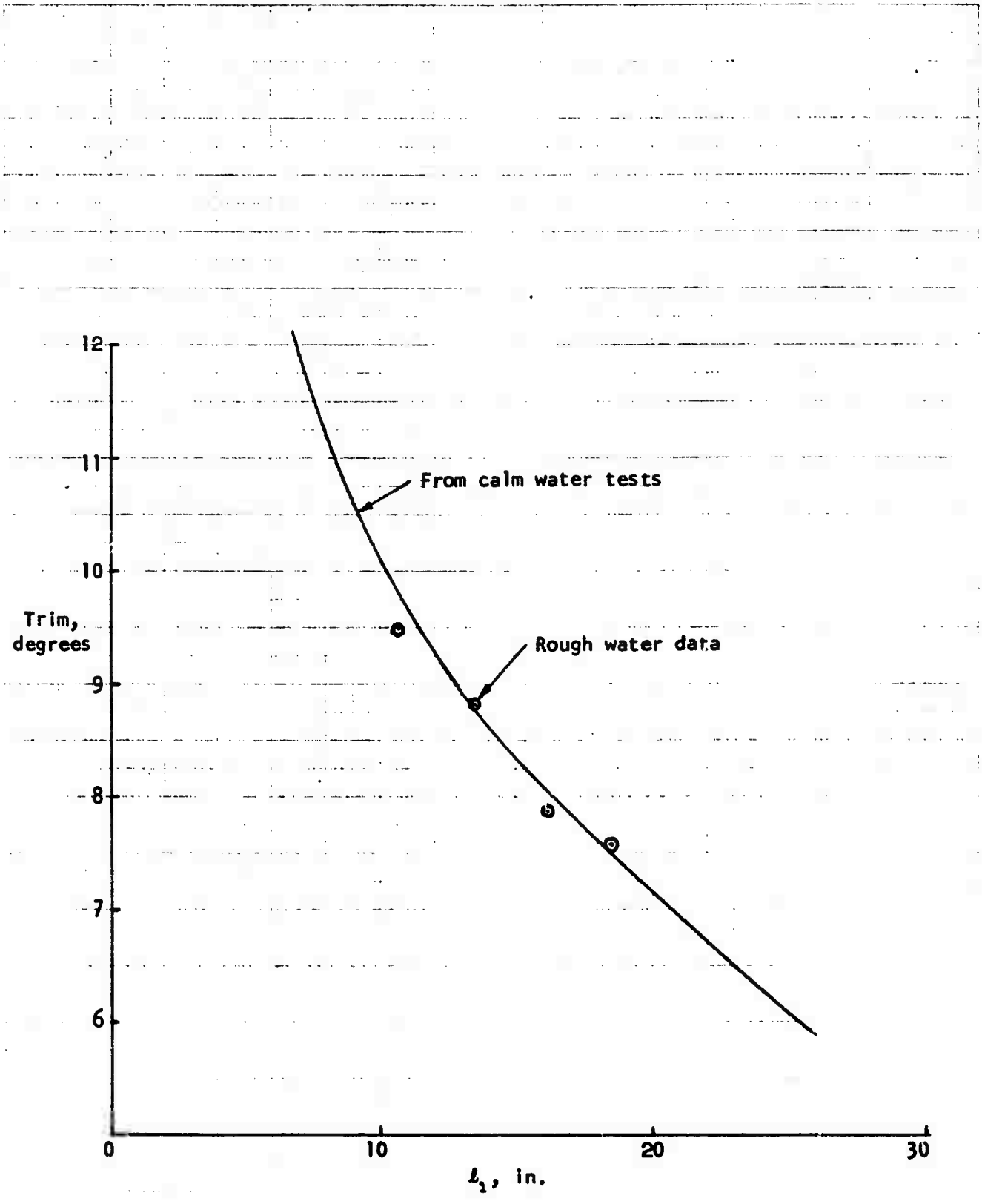


FIGURE A4 COMPARISON OF CALM AND ROUGH WATER LIFT CHARACTERISTICS AT 31 LB LIFT, 14.82 FPS

Flap Lift and Drag

When the flap is deflected on a planing craft equipped with a transom flap, the hydrodynamic configuration is changed. This ought to mean that the entire test matrix of speed, load and trim should be repeated for each value of flap deflection. As long as the flap is a small proportion of the planing area, however, the effect of flap deflection may be considered as generating additions to the forces and moments of the planing craft with zero flap deflection. These additions are spoken of as the flap lift and drag, although they only refer to the increase in these forces due to flap deflection.

Flap Lift

The method of determining the added lift due to flap deflection can best be shown by an example. Consider Run 22 at 14.82 fps in Table A1.4. For this run with 5 degree flap deflection the lift is 35 lb, the trim is 5.9 degrees and the SKWL is 18.14 in. At the same trim and wetted length, interpolating in Figures A2 and A3, the lift with zero flap deflection is estimated to be 22 lb. Hence the flap lift due to 5 degree flap deflection is 13 lb. Proceeding in the same manner the flap lift was determined for all speeds, loads, trims and flap deflections. It may be noted that flap angles of 10 degrees resulted in quite short wetted lengths, this was one reason for extending the range of test conditions to light loads and hence short wetted lengths as shown on Figure A2, in order to obtain comparable conditions with and without flap deflection.

It has been shown[4] that flap lift can be expressed in the form:

$$C_{L_F} = \frac{L_F}{\frac{1}{2}\rho V^2 S_F} = a\,\delta$$

where L_F = added lift due to flap deflection, lb

C_{L_F} = flap lift coefficient

S_F = flap area, sq.ft.

δ = flap deflection, degrees

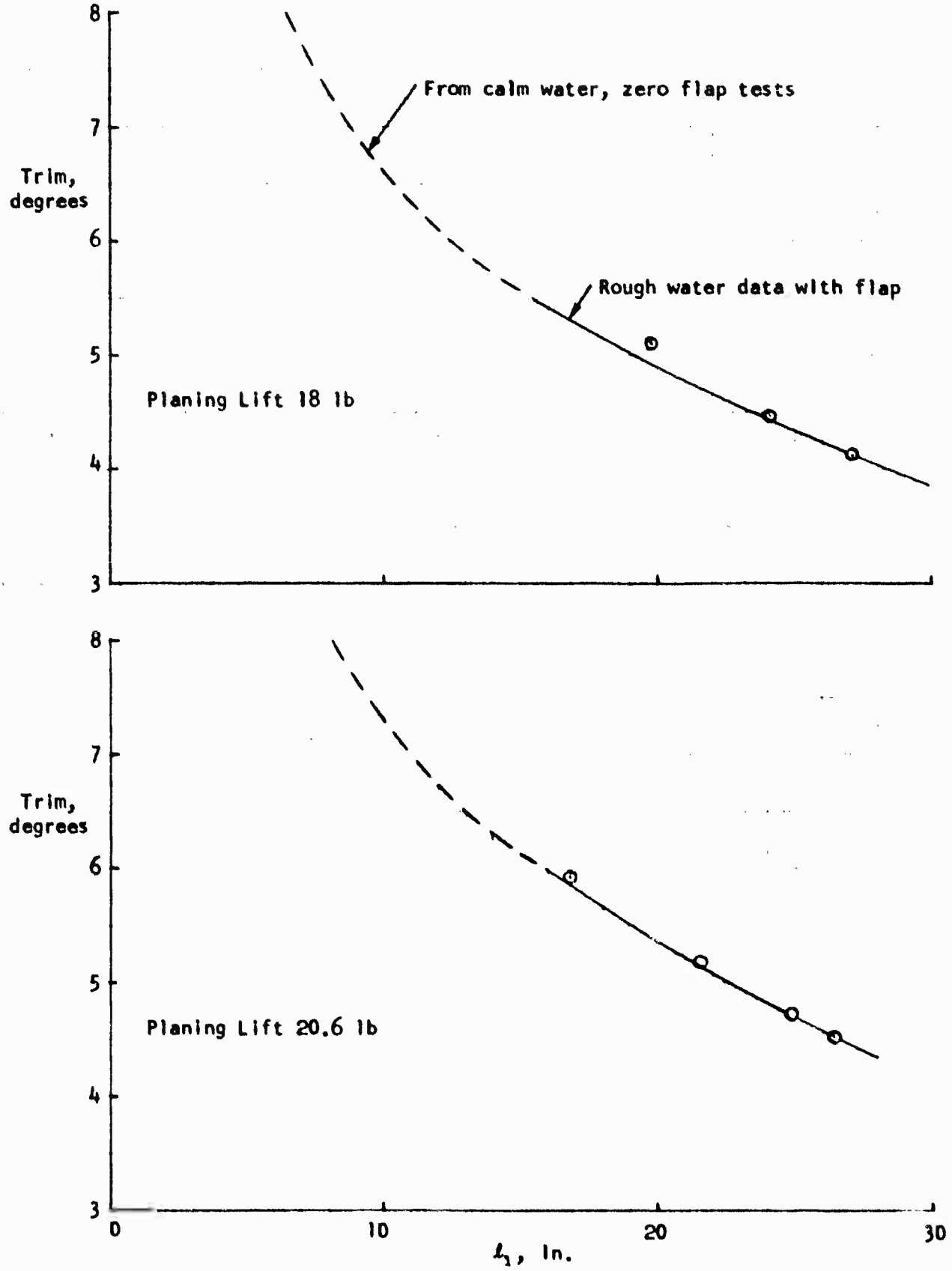


FIGURE A5 COMPARISON OF LIFT CHARACTERISTICS IN CALM AND ROUGH WATER WITH AND WITHOUT FLAP DEFLECTION AT 14.82 FPS

From the data in Table A1, the flap lift coefficient for the 52 sq.ft. transom flap fitted to the MCDEC design is found to be

$$C_{L_F} = 0.0339\ \delta \qquad \text{(A3)}$$

In the study of planing surfaces with trim flaps[4] the flap lift coefficient was given as 0.046δ, hence the MCDEC flap has an efficiency of 74%. This is probably due to the masking effect of the transom and ventilation, though the longitudinal curvature and transverse shape of the MCDEC flap compared to a plane flap may also degrade the flap effectiveness.

At any given speed the flap lift is proportional to the flap deflection. For example at 14.82 fps, from Equation A3, the model flap lift is given by:

$$L_F = 2.6\ \delta,\ \text{lb} \qquad \text{(A4)}$$

Since the effect of flap deflection is assumed to generate additional lift, it follows that the total lift is given by:

$$L = L_p + L_F \qquad \text{(A5)}$$

where L = total lift

L_p = lift at zero flap deflection for given speed, trim and wetted length, referred to briefly as "planing lift"

L_F = additional lift due to flap deflection at same speed, trim and wetted length, referred to briefly as "flap lift"

Since at 14.82 fps the flap lift is known from Equation A4 (or more generally from Equation A3) it follows that the planing, or zero-flap-deflection lift is given by:

$$L_p = L - 2.6\ \delta \qquad \text{(A6)}$$

This equation may be used to reduce the rough water lift data to zero flap conditions. For example, Runs 31, 37 and 55 at 14.82 fps (Table A2.5) where all rough water runs made with 5 degree flap deflection, hence with 13 lb of flap lift and, since the total lift was 31 lb, therefore with 18 lb of planing lift. The data from these runs is shown on Figure A5.

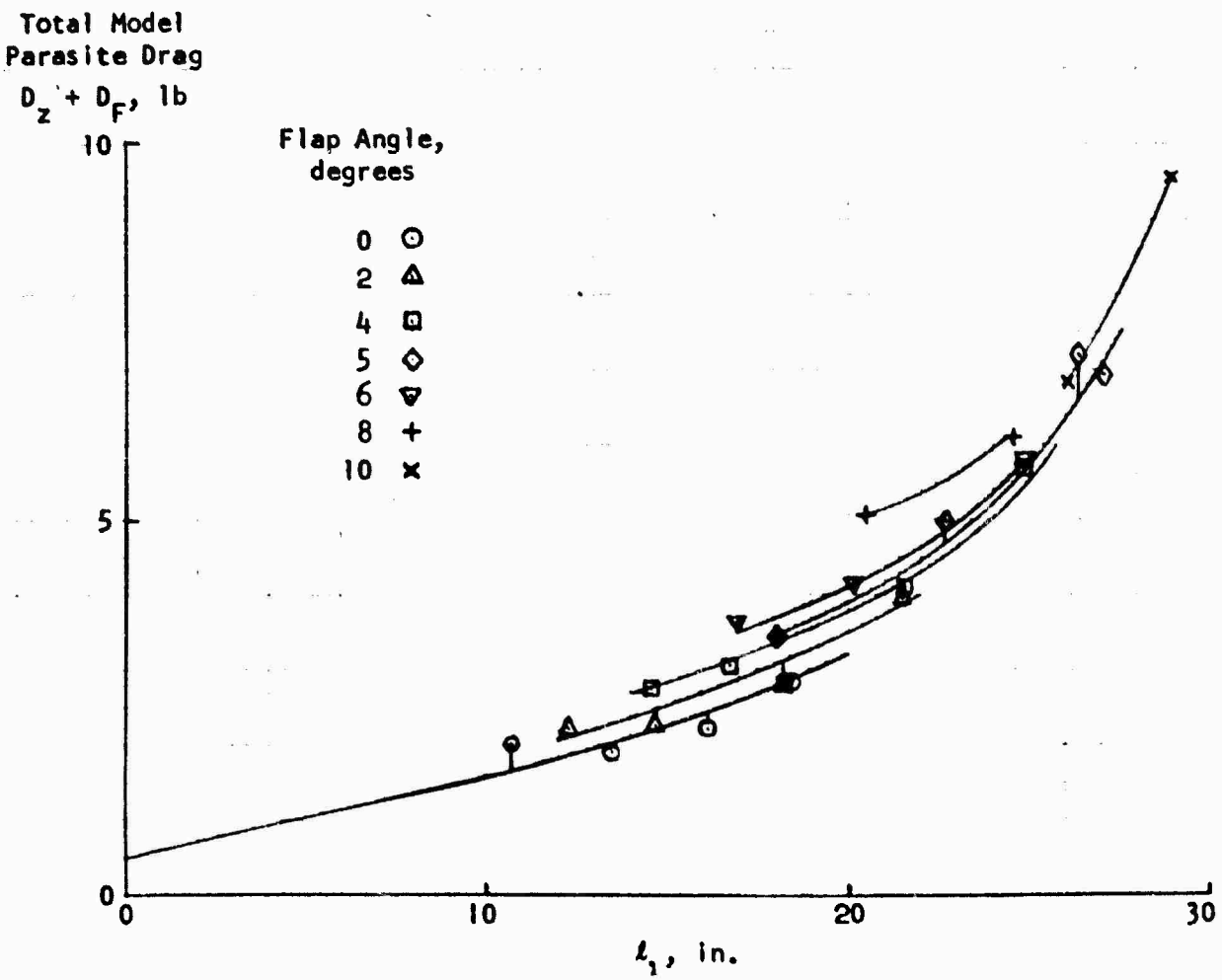


FIGURE A6 VARIATION OF PARASITE DRAG WITH WETTED LENGTH AND FLAP ANGLE AT 14.82 FPS

The dashed part of the curve is interpolated from the calm water data shown on Figure A3. Another example from data taken with 4 degree flap deflection at 31 lb load and 5 degree flap deflection at 33.8 lb load is included on the lower part of the same figure.

It is considered that the correspondence between the zero-flap calm water data and the flapped rough water data shown on Figure A5 demonstrates a satisfactory analysis of the lift characteristics in calm and rough water and of the flap lift effects.

Flap Drag

The added drag due to flap deflection was established in a similar manner to that used to determine flap lift. For a planing craft with zero flap deflection the total drag is made up of induced drag, friction drag, form or profile drag and added drag in waves:

$$D = D_i + D_f + D_p + D_{aw} \tag{A7}$$

The induced drag is equal to the lift times the tangent of the trim angle and, borrowing a term from aircraft performance, the remaining drag is referred to as parasite drag. Hence, recalling that with zero flap deflection $L = L_p$:

$$D = L_p \tan\tau + D_z \tag{A8}$$

where L_p = total lift with zero flap deflection

$D_z = D_f + D_p + D_{aw}$

When, at the same trim and wetted length, the flap is deflected both the lift and drag is increased and hence:

$$D = (L_p + L_F)\tan\tau + D_z + D_F \tag{A9}$$

The flap drag is therefore the increase in parasite drag due to flap deflection.

In the study of planing surfaces with trim flaps[4] the flap drag was expressed in the form:

$$C_{D_F} = \frac{D_F}{\frac{1}{2}\rho V^2 S_F} = b\,\delta(\tau+\delta) \tag{A10}$$

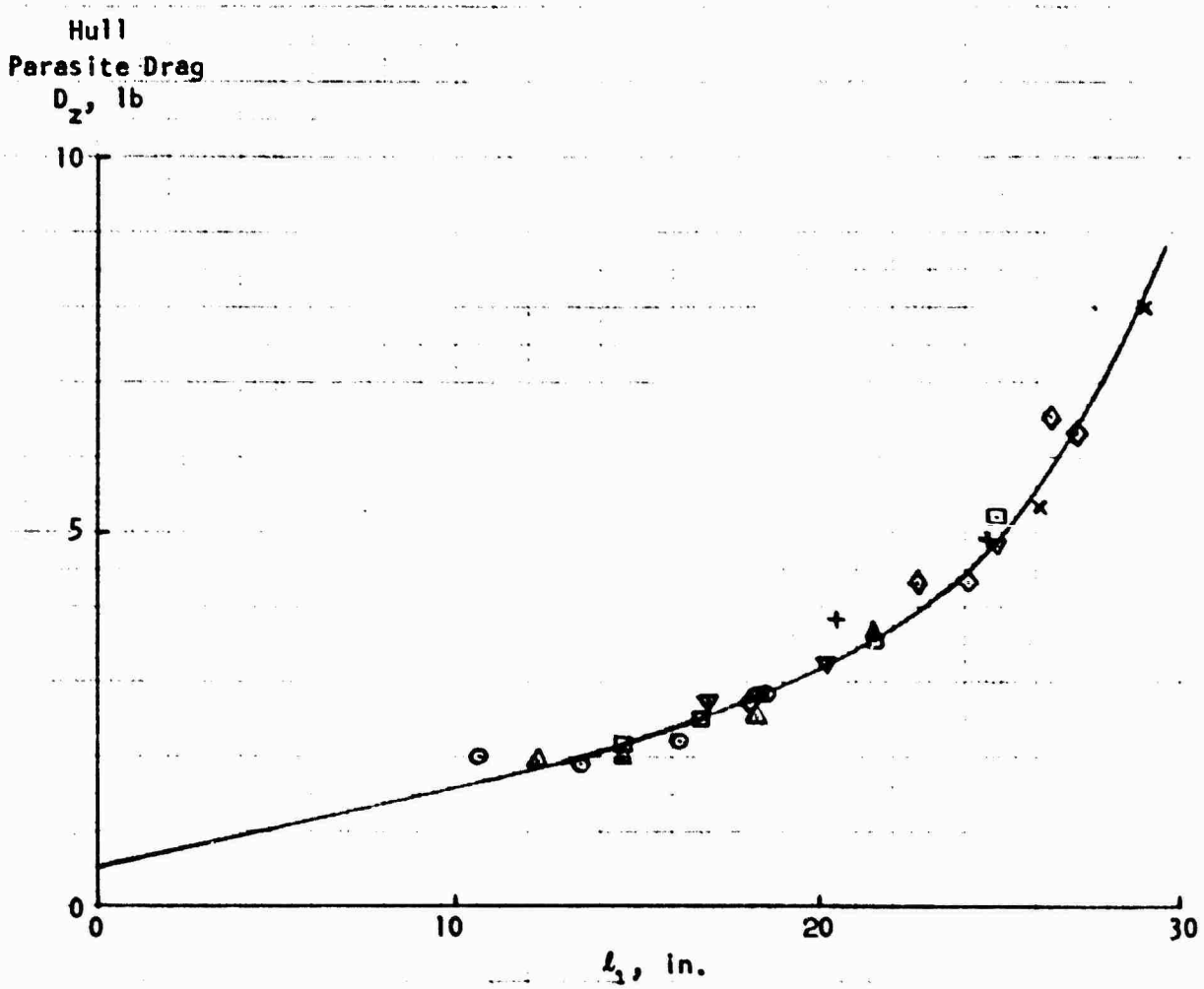


FIGURE A7 REMOVAL OF FLAP DRAG FROM TOTAL MODEL ROUGH WATER PARASITE DRAG AT 14.82 FPS

and it was also shown that

$$C_{D_F} = .00522\ C_{L_F}\ (\tau+\delta) \qquad (A11)$$

Substituting the value of C_{L_F} for the MCDEC flap, from Equation A3, it is expected that:

$$C_{D_F} = .000177\ \delta\ (\tau+\delta) \qquad (A12)$$

Comparison with the calm water data in Table A1 confirmed that Equation A12 did adequately represent the flap drag. This fact tends to confirm the generality of the expression for flap drag given by Equation A11 which was developed in the course of a basic study of flap effects[4].

The application of Equation A12 is discussed in the next section.

Rough Water Drag

The rough water drag data obtained at 14.82 fps is shown on Figure A6 in the form of parasite drag (D - Ltanτ) as a function of the wetted length SKWL. The increase in parasite drag due to flap deflection is quite apparent. When the flap drag given by Equation A12 is subtracted from this data, the data is collapsed into a single curve as shown on Figure A7. This collapse confirms the applicability of the equation for flap drag, Equation A12.

It has previously been shown that the calm water parasite drag is a function of wetted length only[3]. The presentation in Figure A7 shows that the same is true of the rough water parasite drag. This observation eliminates the need to identify the added drag in waves in carrying out the resistance expansion. It may be noted, however, that whereas the calm water parasite drag is proportional to the square of the speed, the same is not true in rough water because the added drag in waves obeys a different law.

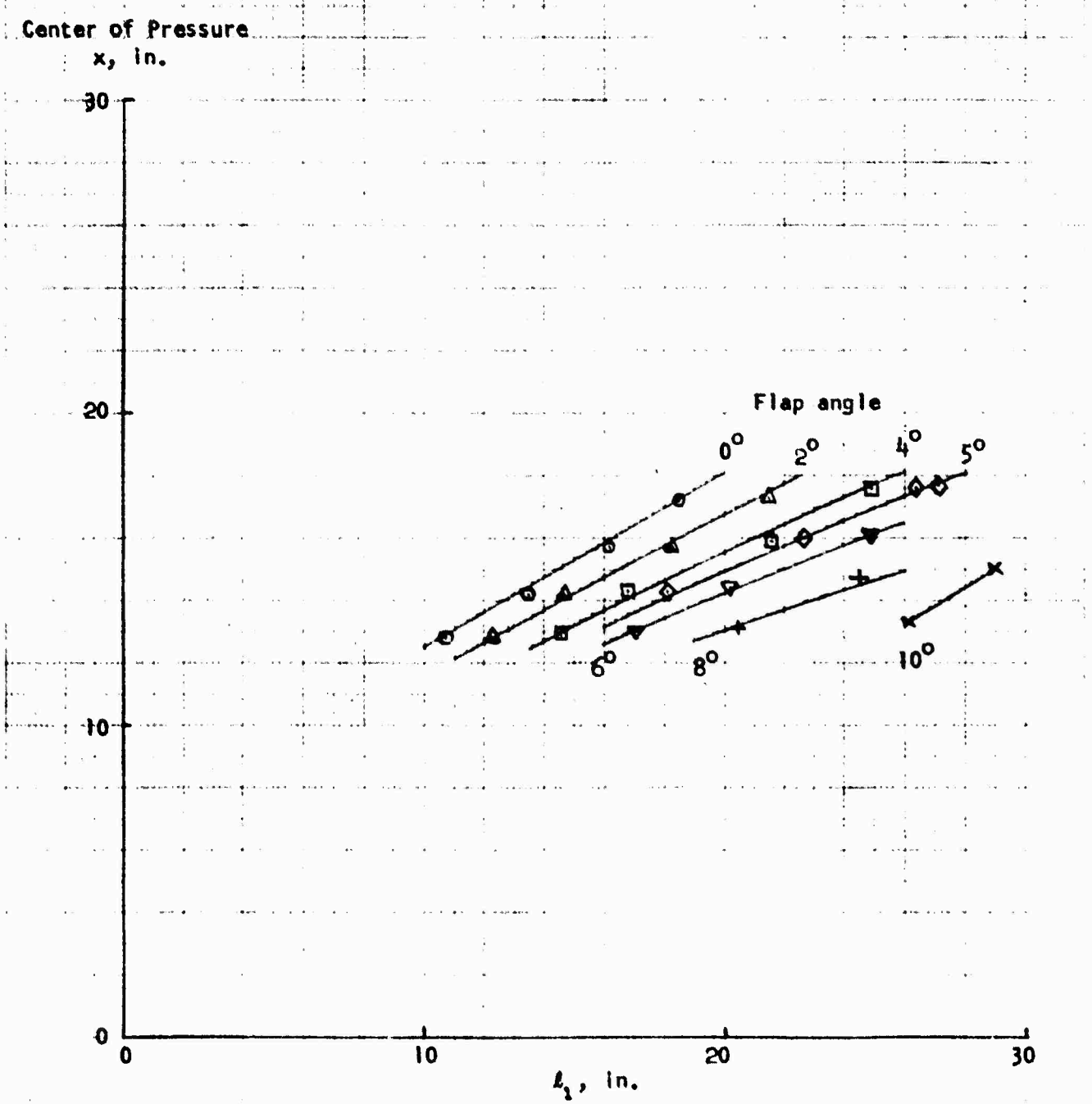
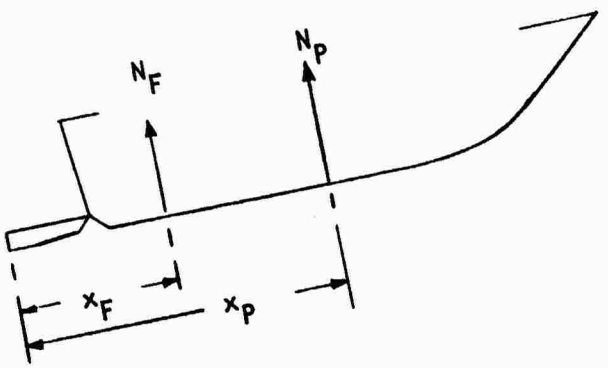


FIGURE A8 EFFECT OF FLAP ON CENTER OF PRESSURE AT 14.82 FPS

Center of Pressure in Rough Water with Flap Deflection

The variation of the center of pressure with wetted length and various amounts of flap deflection is shown on Figure A8 for a speed of 14.82 fps. In analyzing the moments on the hull, the resultant hydrodynamic force is resolved into a force normal to the keel line acting at the center of pressure, and a force acting along the keel line. When the flap is deflected the resulting forces and moments are conceptualized as indicated in the following sketch:



In the absence of flap deflection a normal force, N_P, acts at a distance x_P from the flap trailing edge. In accordance with the concept of added effects due to flap deflection, it is assumed that an additional normal force, N_F, is developed acting at a distance x_F. Under these circumstances it is obvious that the distance of the center of pressure from the flap trailing edge is given by:

$$x = \frac{N_P x_P + N_F x_F}{N_P + N_F} \qquad \text{(A13)}$$

where it will be clear that $x = x_P$ when the flap deflection is zero.

In order to analyze the flap effects it is convenient to replace the normal forces in Equation A13 by the corresponding lift forces:

$$x = \frac{L_P x_P + L_F x_F}{L_P + L_F} \qquad \text{(A14)}$$

It is emphasized that Equation A14 is only used as a device for analyzing data and consequently does not incur any error. On the other hand it is

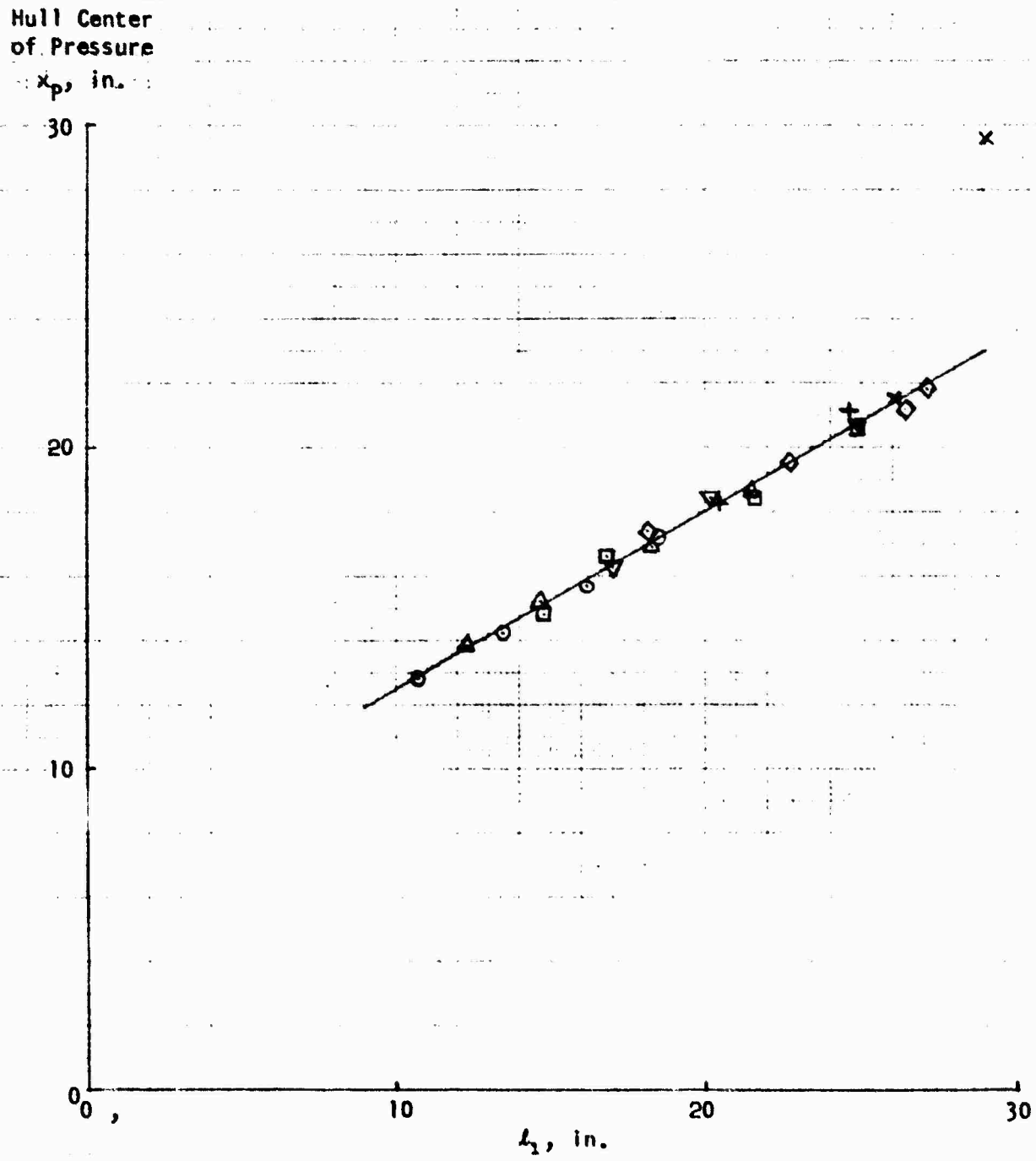


FIGURE A9 REMOVAL OF FLAP EFFECT FROM CENTER OF PRESSURE AT 14.82 FPS

close enough to Equation A13 to be a suitable device: (what is involved formally, is the assumption that the parasite drag is zero and anomalous results may be expected when this condition is seriously violated).

Re-arranging Equation A14 then, and noting that $L = L_P + L_F$:

$$\frac{Lx}{L - L_F} = x_P + \frac{L_F}{L - L_F} \; x_F \qquad \text{(A15)}$$

It is assumed that x_F, like x_P, is at most a function of the wetted length[3]. Thus with a knowledge of L_F from Equation A4, and from cross-plots at constant wetted length of data shown in Figure A8 (V = 14.82 fps, L = 31 lb), it is possible to determine x_F . By this means, and including the data at other speeds, it is found that

$$\frac{x_F}{\ell_1} = \frac{1.76}{(\ell_1/b) + 1.53} \qquad \text{(A16)}$$

where b is the beam. This finding that the position of the flap center of pressure varies with wetted length differs from earlier conclusions[4], based on data gathered at greater length-beam ratios and higher Froude Numbers, but represents the MCDEC flap behavior for $1 < (\ell_1/b) < 2.5$ and $C_v < 3$.

The flap effects may now be removed from the data in Figure A8 by using Equation A15 to find x_P, the center of pressure with zero flap deflection. The result is shown on Figure A9. The collapse is very satisfactory, but note the one point for 10 degree flap deflection at $\ell_1 = 29$ where the parasite drag is too large for Equation A14 to apply, cf Figure A7.

In application the moment on the craft, about the trailing edge of the flap is calculated from:

$$M = N_P x_P + N_F x_F \qquad \text{(A17)}$$

where x_P and x_F are obtained from Figure A9 and Equation A16.

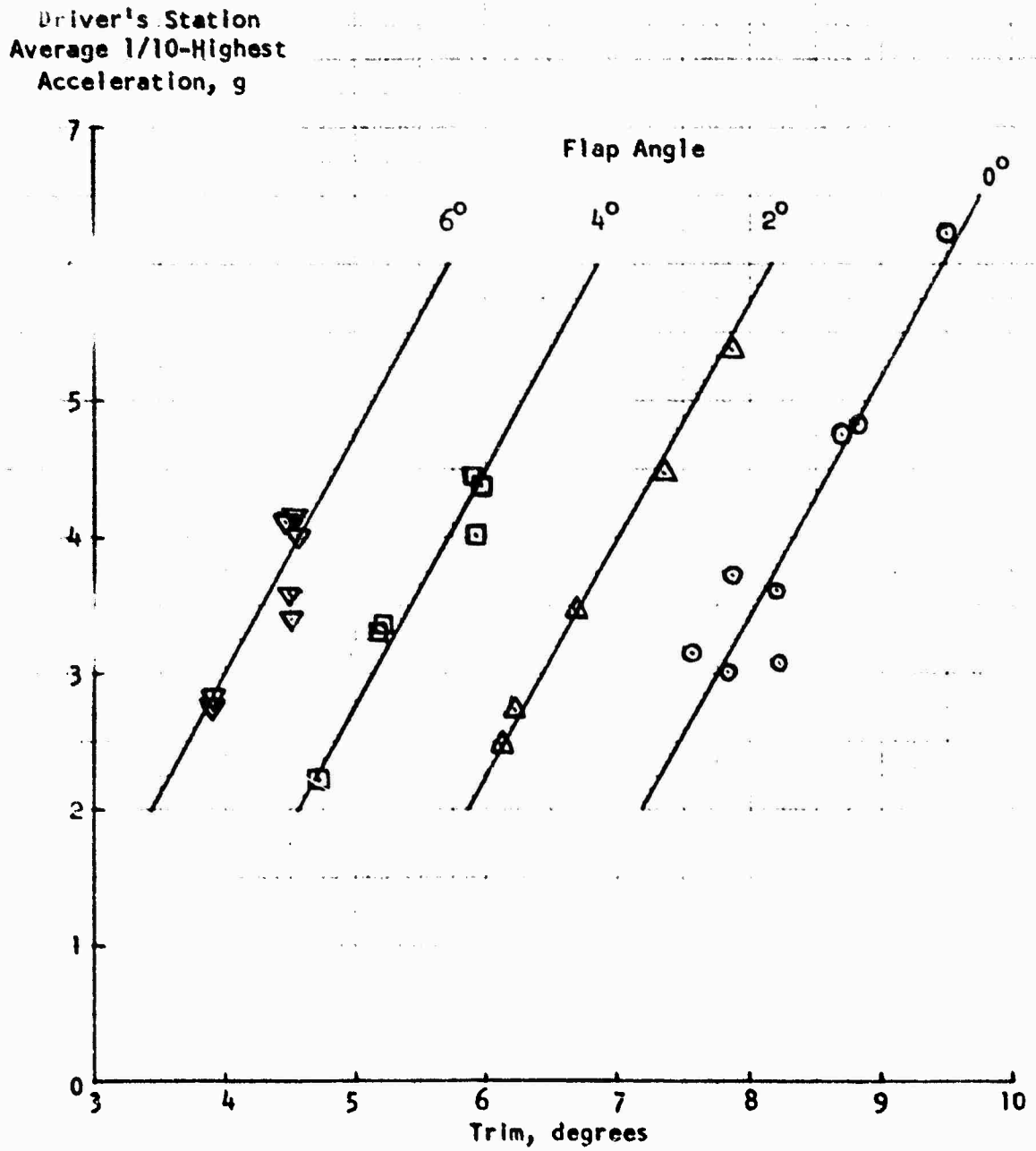


FIGURE A10 VERTICAL ACCELERATION CHARACTERISTICS AT 35 MPH

Acceleration Characteristics

The selection of the optimum LCG and flap angle involves a trade-off between the conflicting requirements of low hump drag and small acceleration loads at cruise speed, as discussed in the main text. Hence it is useful to have a measure of the acceleration characteristics. Since the largest accelerations occur at the driver's station, and these may be represented by the average of the 1/10-highest accelerations, plots are made of acceleration as a function of trim with flap angle as parameter. An example for 14.82 fps is included on Figure A10.

It is clear that the accelerations increase with trim at given flap angle, and increase with flap angle at given trim. Minimizing the accelerations involves operating at low trim but not by deflecting the flap because this deflection itself will cause increased accelerations.

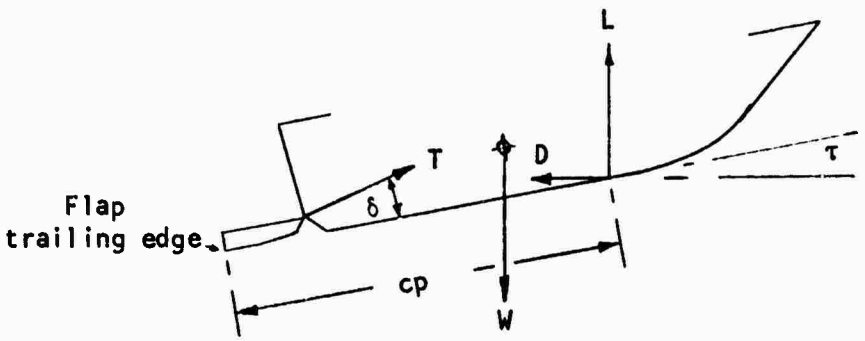
Summary

The data analysis has been described for the most part in terms of the data at 14.82 fps. It should be understood that similar analyses were carried out at all speeds. With this understanding the charts required for performance prediction involve the lift characteristics, Figure A3, the parasite drag characteristics, Figure A7, the moment characteristics, Figure A9 and the acceleration characteristics Figure A10. In addition the flap effects given by Equations A3, A11 and A16 are needed and the relationship between the static and dynamic wetted lengths, Equations A1 and A2.

PERFORMANCE PREDICTION

Performance Equations

The equations governing the performance of the MCDE, LVA are obtained from the equilibrium conditions for the craft moving at constant velocity. The forces on the boat are shown in the following sketch:



The point defined by the intersection of the undeflected flap trailing edge and the baseline is used as the origin of an axis system oriented along and normal to the keel-line (baseline). The waterjet is mounted on the transom flap and its thrust acts through the flap hinge, 0.83 ft above the baseline and 4.92 ft forward of the origin. The distance from the origin to the thrust vector is therefore given by $4.99 \sin(9.58-\delta)$.

For equilibrium of vertical forces:

$$W = L + T\sin(\tau+\delta) \qquad \text{(A18)}$$

For equilibrium of horizontal forces:

$$D = T\cos(\tau+\delta) \qquad \text{(A19)}$$

Eliminating the thrust from Equations A18 and A19 the equation for force equilibrium is:

$$W = L + D\tan(\tau+\delta) \qquad \text{(A20)}$$

For equilibrium of pitching moments:

$$N\ cp = W(LCG\ \cos\tau - VCG\ \sin\tau) + 4.99\ T\sin(9.58-\delta) \quad (A21)$$

where

$$N = L\cos\tau + D\sin\tau \quad (A22)$$

Solving Equation A21 for the LCG, substituting for the thrust from Equation A19 and with a VCG of 3.45 ft, the equation for moment equilibrium is:

$$LCG\ \cos\tau = (N/W)cp + 3.45\ \sin\tau - 4.99(D/W)\sin(9.58-\delta)/\cos(\tau+\delta) \quad (A23)$$

Resistance Expansion

The total resistance of the hull is given by

$$D = L\ \tan\tau + D_z + D_F \quad (A24)$$

where

Total lift, $L = L_P + L_f$

L_P = lift at zero flap deflection

L_F = additional lift due to flap deflection

D_z = parasite drag at zero flap deflection

D_F = added parasite drag due to flap deflection

τ = trim angle of keel

Full-scale ship values are denoted by subscript s and model values by subscript m. The full scale lift and flap drag are obtained from model values by multiplying by the displacement ratio:

$$W_s/W_m = 1775 \quad (A25)$$

The parasite drag is made up of friction drag, profile drag and added drag due to waves

$$D_z = D_f + D_p + D_{aw} \quad (A26)$$

The profile and wave drag are scaled up by the displacement ratio but the friction drag is calculated from the Schoenherr (or ATTC) skin friction coefficient:

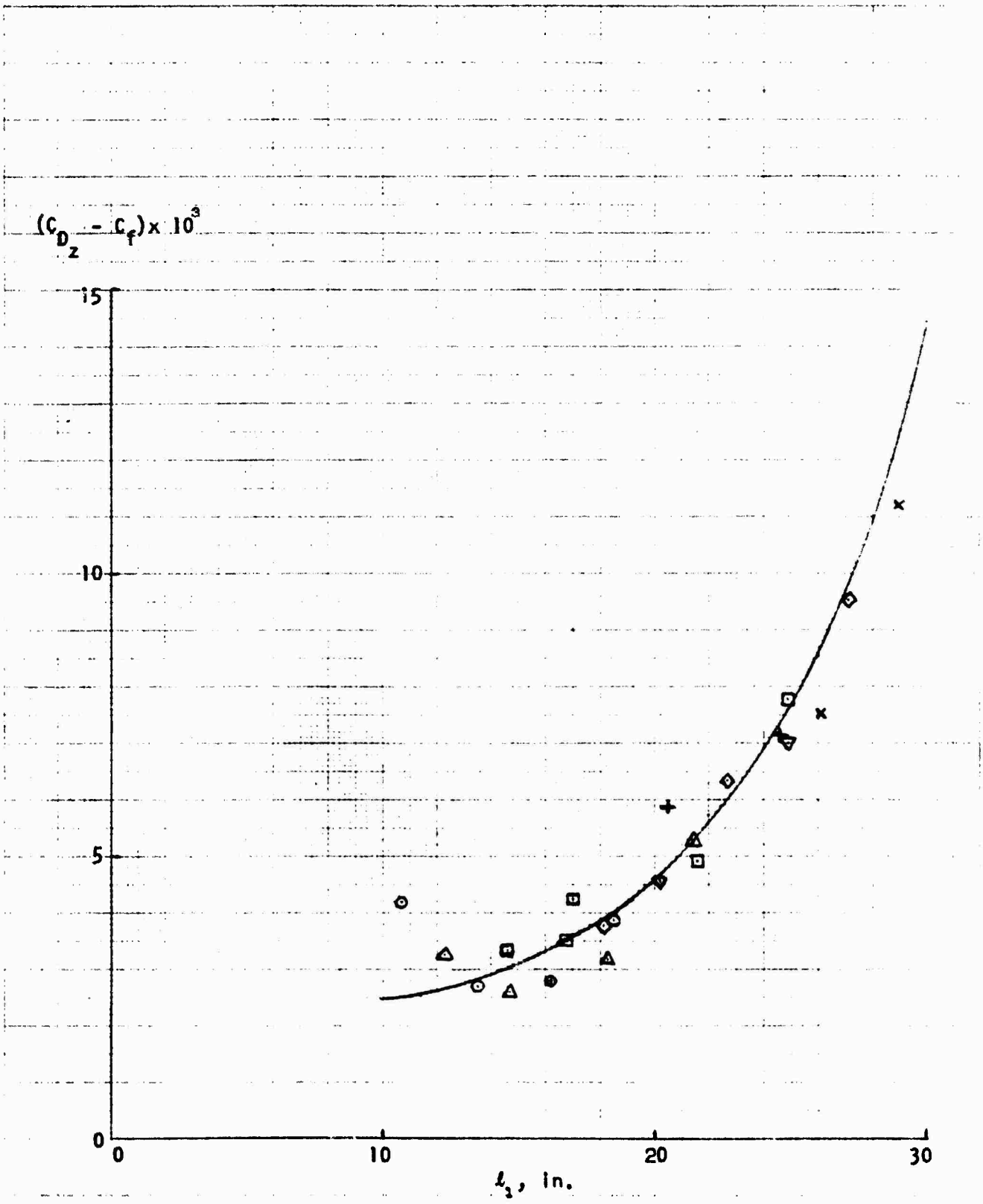


FIGURE A11 PARASITE DRAG LESS SKIN FRICTION DRAG AT 14.82 FPS

$$D_f = \frac{1}{2} \rho V^2 S C_f \tag{A27}$$

where the skin friction coefficient is given by:

$$\frac{.242}{\sqrt{(C_f)}} = \log(C_f R_n) \tag{A28}$$

where:

Reynolds Number, $R_n = V\ell/\nu$

V = velocity, fps

ℓ = wetted length, ft

S = wetted area ℓ b, sq.ft.

b = beam, ft

ρ = mass density of water, slug/cu.ft

ν = kinematic viscosity of water, sq.ft/sec

On this basis from Equation A26

$$D_{z_s} = D_{f_s} + (D_p + D_{aw})_m \, W_s/W_m$$

$$= D_{f_s} + (D_z - D_f)_m \, W_s/W_m$$

hence

$$D_{z_s} = \left[C_{f_s} + (C_{D_z} - C_f)_m\right](1/2 \rho V^2 S)_s \tag{A29}$$

In view of Equation A29 it is convenient to re-plot the parasite drag data shown on Figure A7 in the form shown on Figure A11.

TABLE A

DRAG AND LCG ESTIMATE

55,000 lb, 35 mph, 8° trim, 2° flap

Line	Source	Quantity	Symbol	Units	Value
		MODEL VALUES			
1	Iterated	Lift	L	lb	29.92
2	Eq. A3	Flap lift	L_F	lb	5.20
3	Lines 1-2	'Planing' lift	L_p	lb	24.72
4	Fig. A3	SKWL	λ_1	in.	11.40
5	Fig. A11	Parasite drag	$(C_{D_z}-C_f)\times10^3$		2.54
		SHIP VALUES			
6	Eq. A1	Watted length	ℓ	ft	15.82
7		Raynolds Number	R_n	10^7	6.33
8	Eq. A28	Skin friction coef.	C_f	10^{-3}	2.21
9	Lines 5 + 8	Parasite drag coef.	C_{D_z}	10^{-3}	4.75
10	$28.80\ \ell C_{D_z}\times10^3$	Parasite drag	D	lb	2,164
11	1775 x line 3	Planing lift	L_p	lb	43,878
12		L_p tanτ		lb	6,167
13	Lines 10 + 12	'Planing' drag	D_p	lb	8,331
14	Eq. A32	Flap drag	D_F	lb	482
15	Eq. A31	Flap lift	L_F	lb	9,232
16		L_F tanτ		lb	1,297
17	Lines 14 + 16	Total flap drag	D_{F_T}	lb	1,779
18	Lines 13 + 17	Total drag	D	lb	10,110
19		D tan(τ+θ)		lb	1,783
20	Lines 11 + 15	Total lift		lb	53,110
21	Lines 19 + 20, Eq. A20	Weight	W	lb	54,893
22		Weight	W	lb	55,000
23	Eq. A33	Drag	D	lb	10,120
		LCG			
24	Eq. A34	Normal force	N	lb	54,106
25	Eq. A35	Flap normal force	N_F	lb	9,390
26	Eq. A36	'Planing' normal force	N_p	lb	44,716
27	Fig. A9	'Planing' cp	x_p	ft	13.30
28	Eq. A16	Flap cp	x_F	ft	7.82
29	Eq. A17	N cp/W		ft	12.15
30		3.45 sinτ		ft	.48
31	$4.99(D/W)\sin(9.58-\theta)/\cos(\tau+\theta)$			ft	.12
32	Lines 29 + 30-31	LCG cost		ft	12.50
33		LCG from flap T.E.		ft	12.63
34	Line 33-(4.92)	LCG from transom		ft	7.71

Worked Example

The method of performance prediction is illustrated by a worked example for the following conditions:

Gross weight, lb	55,000
Speed, mph	35
Speed, fps	51.33
Trim, degrees	8
Flap angle, degrees	2

As a starting point the lift is assumed. From Equations A20 and A24:

$$L = \frac{W - (D_z + D_F)\tan(\tau+\delta)}{1 + \tan\tau \tan(\tau+\delta)} \qquad (A30)$$

From Equations A3 and A11, the flap lift and drag for the flap area of 52 sq.ft. are given by

$$L_F = 4616\,\delta = 9{,}232 \text{ lb} \qquad (A31)$$

$$D_F = 48.2(\tau+\delta) = 482 \text{ lb} \qquad (A32)$$

Assuming D_z is 5% of the weight, then from Equation A30:

$$L_s = 53{,}114 \text{ lb}$$

$$L_m = L_s/1775 = 29.92 \text{ lb}$$

The calculation then proceeds as in Table A. Starting with the assumed lift, the corresponding drag is determined, Line 18 and the craft weight, Line 21. This is an iterative process and if the craft weight is in error by more than 0.5%, a new value of lift is estimated from Equation A30 using the last value of D_z on Line 10.

If the craft weight is within 0.5%, the resistance for the required weight of 55,000 lb is calculated from the following equation derived from Equations A20 and A24:

$$D = \frac{W\tan\tau + D_z + D_F}{1 + \tan\tau \tan(\tau+\delta)} \qquad (A33)$$

The LCG is now found from Equation A23. Since the thrust is parallel to the flap, the total normal force is given by

$$N = W \cos\tau - \frac{D \sin\delta}{\cos(\tau+\delta)} \tag{A34}$$

The contribution to the normal force due to flap deflection is

$$N_F = [(L_F \tan\tau + D_F)\tan\tau + L_F] \cos\tau$$

$$= (D_{F_T} \tan\tau + L_F) \cos\tau \tag{A35}$$

and N_P is found from

$$N_P = N - N_F \tag{A36}$$

The calculation is completed as shown in Table A.

The above calculation is repeated for all trims and flap angles of interest. As a final step the trim and the quantity:

$$D_z = D - [W - D \tan(\tau+\delta] \tan\tau - D_F \tag{A37}$$

using the total drag from Line 23, is plotted as a function of ℓ_1. The LCG is plotted as a function of trim. These faired curves are used to guard against error and for interpolating to obtain the drag at specific values of LCG.

The above procedure is repeated for each speed.

TABLE A1.1

CALM WATER FIXED-TRIM MODEL RESULTS AT 8.47 fps (20 mph)

RUN	SPEED	FLAP	LIFT	TRIM	DRAG	CP	WL	SKWL	R-DTANT	CG DEPT	P-MOM
166	8.47	0.0	5.0	6.06	0.99	9.34		11.41	0.46	-0.57	-3.36
167	8.47	0.0	5.0	8.09	1.23	6.42		7.41	0.52	-1.31	-4.66
168	8.47	0.0	5.0	10.08	1.29	4.09		5.12	0.40	-2.02	-5.64
169	8.47	0.0	5.0	12.16	1.62	2.20		4.01	0.54	-2.66	-6.59
185	8.46	0.0	10.0	6.02	1.78	13.50		19.78	0.72	0.31	-3.15
182	8.47	0.0	10.0	8.04	1.94	11.53		14.89	0.53	-0.26	-4.77
180	8.47	0.0	10.0	10.18	2.33	9.54		11.24	0.53	-0.96	-6.51
178	8.47	0.0	10.0	12.11	3.53	7.92		8.69	0.39	-1.66	-7.89
162	8.48	0.0	15.0	6.02	2.69	15.40		24.60	1.11	0.88	-2.32
163	8.47	0.0	15.0	8.04	2.95	13.89		20.20	0.83	0.48	-4.17
164	8.47	0.0	15.0	10.08	3.27	12.34		16.48	0.60	-0.03	-6.10
165	8.47	0.0	15.0	12.12	3.65	10.86		13.39	0.43	-0.68	-7.99
198	8.48	0.0	20.0	8.02	4.29	15.18		24.96	1.37	1.23	-3.45
201	8.47	0.0	20.0	10.04	4.48	13.89		21.32	0.94	0.81	-5.53
204	8.47	0.0	20.0	12.08	5.08	12.69		17.79	0.80	0.25	-7.60
56	8.47	0.0	25.0	6.10	6.72	17.12	30.90	29.31	4.05	2.17	-0.86
60	8.47	0.0	25.0	8.02	5.96	16.05	30.40	27.41	2.43	1.79	-2.67
64	8.47	0.0	25.0	10.03	5.80	14.96	27.90	24.46	1.38	1.40	-4.70
68	8.47	0.0	25.0	12.04	6.29	13.95	25.90	21.35	0.96	0.99	-6.77
104	8.47	0.0	30.0	5.91	8.60	17.80		30.27	5.50	2.75	0.54
108	8.48	0.0	30.0	6.92	8.61	17.27		29.65	4.97	2.58	-0.66
112	8.48	0.0	30.0	7.92	8.52	16.80		29.09	4.35	2.42	-1.69
116	8.48	0.0	30.0	8.96	8.11	16.24		28.09	3.38	2.20	-2.86
120	8.47	0.0	30.0	9.96	7.84	15.73		27.14	2.57	2.06	-3.94
124	8.47	0.0	30.0	10.96	7.98	15.32		25.78	2.17	1.87	-4.90
128	8.48	0.0	30.0	11.99	7.90	14.79		24.24	1.52	1.62	-6.09
1	8.48	0.0	35.0	5.95	10.26	18.01		30.93	6.61	3.23	1.19
2	8.47	0.0	35.0	5.96	10.28	18.03	32.20	30.94	6.62	3.25	1.24
6	8.47	0.0	35.0	7.98	10.54	17.25	31.40	29.90	5.44	2.98	-0.80
11	8.47	0.0	35.0	9.98	10.44	16.34		28.68	4.28	2.61	-3.15
15	8.47	0.0	35.0	12.01	10.23	15.50	30.40	26.57	2.78	2.26	-5.26
72	8.47	5.0	25.0	6.04	5.86	15.19	30.90	28.46	3.72	1.72	-4.72
76	8.47	5.0	25.0	8.05	5.40	14.04	28.30	25.28	1.86	1.30	-6.78
80	8.47	5.0	25.0	10.08	5.72	12.94	25.10	21.63	1.28	0.87	-8.99
84	8.47	5.0	25.0	12.10	6.46	11.89	22.20	18.48	1.10	0.39	-11.25
19	8.47	5.0	35.0	5.90	9.82	16.59	32.20	30.47	6.20	2.89	-2.94
23	8.47	5.0	35.0	7.93	10.04	15.75	30.90	29.29	5.16	2.56	-5.16
28	8.47	5.0	35.0	9.98	9.75	14.84	29.40	27.36	3.59	2.14	-7.46
32	8.46	5.0	35.0	11.99	9.91	13.98	26.90	24.83	2.47	1.78	-9.77
88	8.46	10.0	25.0	6.01	5.14	13.28	29.10	26.70	2.51	1.73	-8.55
92	8.46	10.0	25.0	8.02	5.39	12.16	25.90	23.58	1.87	0.81	-10.77
96	8.48	10.0	25.0	10.10	6.23	11.15	22.40	18.64	1.77	0.34	-13.00
100	8.47	10.0	25.0	12.12	6.92	10.20	19.10	15.34	1.55	-0.27	-15.06
36	8.47	10.0	35.0	5.84	9.78	15.28		29.94	6.20	2.52	-6.85
37	8.47	10.0	35.0	5.87	9.71	15.26		29.92	6.11	2.55	-6.87
43	8.47	10.0	35.0	7.97	9.52	14.35	30.90	28.35	4.61	2.09	-9.19
47	8.47	10.0	35.0	10.01	9.23	13.45	29.40	25.59	3.05	1.67	-11.48
51	8.47	10.0	35.0	12.04	9.95	12.65	26.60	22.72	2.48	1.27	-13.79
Units	fps	deg	lb	deg	lb	in.	in.	in.	lb	in.	ft-lb

TABLE A1.2

CALM WATER FIXED-TRIM MODEL RESULTS AT 10.58 fps (25 mph)

RUN	SPEED	FLAP	LIFT	TRIM	DRAG	CP	WL	SKWL	R-DTANT	CG DEPT	P-MOM
170	10.59	0.0	5.0	5.99	1.27	5.45		5.29	0.74	-1.20	-5.12
172	10.58	0.0	5.0	8.05	1.49	3.33		3.72	0.78	-1.82	-6.09
174	10.58	0.0	5.0	10.18	0.98	3.96		2.17	0.08	-2.56	-5.55
176	10.59	0.0	5.0	12.18	1.22	2.81		1.85	0.14	-3.11	-6.12
186	10.58	0.0	10.0	6.03	1.79	11.99		14.24	0.74	-0.27	-4.43
183	10.58	0.0	10.0	8.01	1.96	8.22		8.50	0.56	-1.15	-7.59
181	10.57	0.0	10.0	10.14	2.26	5.83		5.28	0.47	-2.01	-9.65
179	10.58	0.0	10.0	12.08	2.77	4.49		3.88	0.63	-2.66	-10.96
188	10.57	0.0	15.0	6.02	2.72	15.71		21.38	1.14	0.48	-1.93
190	10.58	0.0	15.0	8.05	2.94	12.49		14.97	0.82	-0.25	-5.95
192	10.59	0.0	15.0	10.05	3.26	9.63		10.39	0.60	-1.10	-9.57
194	10.58	0.0	15.0	12.05	3.71	7.54		7.38	0.51	-1.93	-12.30
196	10.59	0.0	20.0	6.00	4.19	17.58		25.73	2.09	1.07	0.42
199	10.58	0.0	20.0	8.03	3.95	15.19		20.32	1.13	0.50	-3.37
202	10.57	0.0	20.0	10.04	4.34	12.63		15.37	0.80	-0.23	-7.64
203	10.58	0.0	20.0	10.05	4.39	12.65		14.95	0.85	-0.30	-7.63
205	10.57	0.0	20.0	12.06	4.95	10.41		11.34	0.67	-1.10	-11.47
57	10.58	0.0	25.0	6.11	6.83	18.55	30.10	28.00	4.15	1.60	2.16
61	10.57	0.0	25.0	8.04	5.42	16.90	28.10	24.38	1.89	1.11	-0.71
65	10.58	0.0	25.0	10.04	5.51	14.79	23.30	19.20	1.08	0.45	-4.97
69	10.58	0.0	25.0	12.04	6.07	12.63	19.20	15.39	0.73	-0.28	-9.52
105	10.58	0.0	30.0	5.95	10.25	19.53		29.46	7.12	2.24	4.52
109	10.58	0.0	30.0	6.96	9.19	18.73		28.53	5.52	1.94	2.94
113	10.58	0.0	30.0	7.95	8.02	17.94		27.12	3.83	1.68	1.37
117	10.57	0.0	30.0	8.98	7.43	17.20		25.24	2.69	1.43	-0.21
121	10.57	0.0	30.0	9.97	7.07	16.33		23.15	1.80	1.12	-2.17
125	10.58	0.0	30.0	10.98	7.25	15.47		20.98	1.43	0.82	-4.29
129	10.58	0.0	30.0	11.99	7.52	14.43		18.75	1.15	0.44	-6.88
3	10.58	0.0	35.0	6.00	12.49	20.08	31.90	30.30	8.81	2.80	6.82
7	10.58	0.0	35.0	8.01	11.39	18.61	31.90	28.88	6.47	2.30	3.08
8	10.58	0.0	35.0	8.02	11.49	18.69	31.90	28.85	6.55	2.28	3.30
12	10.58	0.0	35.0	10.04	9.78	17.34	29.20	26.09	3.58	1.79	0.08
16	10.58	0.0	35.0	12.04	9.32	15.80	25.90	22.05	1.85	1.13	-4.09
73	10.57	5.0	25.0	6.05	4.83	14.80	27.90	24.83	2.18	0.93	-5.23
77	10.58	5.0	25.0	8.03	4.90	12.68	23.20	18.67	1.37	0.27	-9.51
81	10.58	5.0	25.0	10.04	5.54	10.69	17.90	13.90	1.11	-0.48	-13.72
85	10.57	5.0	25.0	12.05	6.35	9.06	14.20	10.55	1.01	-1.27	-17.30
20	10.58	5.0	35.0	5.91	10.92	17.29	30.90	29.38	7.29	2.12	-1.17
24	10.59	5.0	35.0	7.94	8.89	15.84	30.20	26.56	4.01	1.54	-4.56
29	10.58	5.0	35.0	9.97	8.29	14.31	27.90	21.99	2.14	0.92	-8.59
33	10.58	5.0	35.0	12.07	9.13	12.70	22.60	17.89	1.64	0.27	-13.44
89	10.59	10.0	25.0	5.98	4.59	10.85	21.30	17.57	1.97	0.08	-13.50
93	10.58	10.0	25.0	7.96	5.31	9.07	17.10	12.15	1.81	-0.64	-17.32
97	10.58	10.0	25.0	10.04	6.14	7.66	13.70	8.48	1.71	-1.43	-20.43
101	10.58	10.0	25.0	12.03	7.17	6.72	10.90	6.37	1.85	-2.14	-22.70
38	10.57	10.0	35.0	5.84	8.61	14.63		27.05	5.04	1.42	-8.42
44	10.58	10.0	35.0	7.95	7.82	13.17	27.50	23.64	2.93	0.82	-12.18
48	10.58	10.0	35.0	9.97	8.47	11.52	21.90	17.08	2.32	0.07	-17.01
52	10.58	10.0	35.0	11.99	9.65	10.20	17.90	13.93	2.22	-0.56	-21.10

TABLE A1.3

CALM WATER FIXED-TRIM MODEL RESULTS AT 12.70 fps (30 mph)

RUN	SPEED	FLAP	LIFT	TRIM	DRAG	CP	WL	SINK	R-DTANT	CG DEPT	P-MOM
171	12.68	0.0	5.0	5.98	1.14	3.39		4.94	0.62	-1.34	-5.94
173	12.70	0.0	5.0	8.05	0.92	2.67		2.36	0.22	-2.01	-6.12
175	12.70	0.0	5.0	10.22	0.97	2.64		1.69	0.07	-2.66	-6.11
177	12.68	0.0	5.0	12.13	1.14	1.67		1.37	0.07	-3.20	-6.56
187	12.70	0.0	10.0	5.98	1.89	7.91		8.48	0.84	-0.87	-7.91
184	12.71	0.0	10.0	7.98	2.20	4.50		4.65	0.79	-1.68	-10.84
189	12.71	0.0	15.0	6.01	2.78	13.28		15.16	1.20	-0.17	-5.03
191	12.70	0.0	15.0	7.99	2.92	8.56		8.55	0.86	-1.14	-10.96
193	12.69	0.0	15.0	9.98	3.39	5.87		5.26	0.75	-1.98	-14.43
195	12.71	0.0	15.0	12.01	3.93	4.36		3.68	0.74	-2.69	-16.49
197	12.70	0.0	20.0	6.00	3.79	17.01		21.16	1.68	0.46	-0.43
200	12.71	0.0	20.0	8.03	3.98	12.37		13.66	1.16	-0.43	-8.15
58	12.70	0.0	25.0	6.03	5.91	19.32	28.70	25.42	3.27	1.02	4.03
62	12.72	0.0	25.0	8.03	4.95	15.44	22.70	18.22	1.22	0.21	-3.68
66	12.72	0.0	25.0	10.02	5.52	11.76	16.10	12.47	1.11	-0.73	-11.44
70	12.71	0.0	25.0	11.99	6.22	9.05	12.90	8.91	0.92	-1.60	-17.26
106	12.70	0.0	30.0	5.98	10.02	20.82		27.94	6.88	1.56	7.92
110	12.70	0.0	30.0	6.99	7.51	19.21		25.49	3.83	1.18	4.62
114	12.70	0.0	30.0	7.96	6.52	17.68		22.38	2.32	0.78	1.13
118	12.68	0.0	30.0	8.96	6.53	16.02		19.04	1.80	0.36	-2.96
122	12.72	0.0	30.0	9.95	6.65	14.31		16.25	1.39	-0.07	-7.21
126	12.69	0.0	30.0	10.94	7.13	12.90		14.25	1.33	-0.46	-10.84
130	12.70	0.0	30.0	11.93	7.43	11.33		11.79	1.09	-1.00	-14.84
4	12.70	0.0	35.0	6.05	13.97	21.66	31.70	29.29	10.26	2.15	11.22
9	12.69	0.0	35.0	8.05	9.42	19.05	29.40	25.71	4.47	1.39	4.95
13	12.70	0.0	35.0	10.04	8.14	16.20	25.40	19.89	1.95	0.56	-2.88
17	12.71	0.0	35.0	12.01	8.99	13.42	19.90	15.31	1.54	-0.27	-11.14
206	12.69	0.0	40.0	10.00	10.24	17.59		22.84	3.19	1.07	1.19
207	12.69	0.0	40.0	12.04	10.26	14.94		17.61	1.73	0.21	-7.51
74	12.68	5.0	25.0	5.98	4.32	11.89	20.70	16.49	1.70	-0.04	-11.22
78	12.70	5.0	25.0	7.99	4.98	8.64	13.70	9.55	1.48	-1.00	-18.10
82	12.72	5.0	25.0	9.92	5.76	6.63	9.90	5.84	1.38	-1.87	-22.48
86	12.69	5.0	25.0	11.94	6.81	5.52	8.70	4.14	1.55	-2.58	-25.14
21	12.68	5.0	35.0	5.92	8.73	16.71	29.90	26.34	5.10	1.16	-2.26
25	12.70	5.0	35.0	7.87	6.96	13.72	23.90	18.75	2.12	0.28	-10.28
30	12.70	5.0	35.0	9.89	7.91	10.99	18.20	13.17	1.81	-0.60	-18.41
34	12.70	5.0	35.0	11.97	9.07	8.84	14.60	9.15	1.64	-1.55	-24.96
90	12.70	10.0	25.0	5.89	4.92	6.36	10.30	4.98	2.34	-1.21	-23.12
94	12.70	10.0	25.0	7.87	5.98	5.29	8.10	2.54	2.55	-1.94	-25.65
98	12.70	10.0	25.0	9.96	7.34	4.59	7.50	1.79	2.94	-2.58	-27.58
102	12.70	10.0	25.0	11.96	8.66	4.24	6.10	1.18	3.36	-3.20	-28.82
39	12.71	10.0	35.0	5.82	6.62	11.61	22.70	18.50	3.05	0.17	-16.75
45	12.68	10.0	35.0	7.85	7.44	9.00	15.90	10.23	2.61	-0.82	-24.48
49	12.68	10.0	35.0	9.86	8.80	7.41	13.40	7.17	2.71	-1.63	-29.48
53	12.70	10.0	35.0	11.86	10.25	6.36	9.60	5.08	2.90	-2.37	-32.99

TABLE A1.4

CALM WATER FIXED-TRIM MODEL RESULTS AT 14.82 fps (35 mph)

RUN	SPEED	FLAP	LIFT	TRIM	DRAG	CP	WL	SKWL	R-DTANT	CG DRFT	P-MOM
140	14.84	0.0	10.0	6.04	2.60	5.41		4.96	1.54	-1.24	-10.29
141	14.80	0.0	10.0	7.98	2.26	3.71		2.97	0.85	-1.91	-11.54
142	14.83	0.0	10.0	10.09	2.04	3.21		2.07	0.26	-2.56	-11.79
143	14.82	0.0	10.0	12.15	2.21	3.03		1.60	0.06	-3.16	-11.92
152	14.78	0.0	12.5	9.93	2.99	3.35		2.39	0.80	-2.46	-14.80
151	14.83	0.0	12.5	10.03	2.98	3.46		2.45	0.77	-2.48	-14.67
136	14.83	0.0	15.0	5.97	2.81	9.46		9.35	1.24	-0.78	-9.88
137	14.77	0.0	15.0	7.95	3.02	5.71		4.75	0.93	-1.66	-14.61
145	14.79	0.0	15.0	8.96	3.87	4.70		3.74	1.51	-2.02	-16.21
138	14.81	0.0	15.0	9.97	4.13	4.27		3.22	1.49	-2.33	-16.83
144	14.83	0.0	15.0	10.02	4.20	4.26		3.22	1.55	-2.34	-16.87
146	14.83	0.0	15.0	11.00	4.17	3.62		2.77	1.26	-2.65	-17.63
139	14.82	0.0	15.0	12.05	4.02	3.33		2.35	0.82	-2.98	-17.87
153	14.83	0.0	17.8	10.00	4.40	4.99		3.55	1.27	-2.28	-18.64
132	14.83	0.0	20.0	6.01	3.62	13.68		14.69	1.52	-0.22	-6.01
133	14.82	0.0	20.0	7.91	3.87	8.43		7.85	1.09	-1.22	-14.81
134	14.81	0.0	20.0	9.90	4.37	5.88		4.44	0.88	-2.11	-19.17
154	14.81	0.0	20.0	9.96	4.38	5.62		4.32	0.87	-2.14	-19.61
135	14.82	0.0	20.0	11.95	5.43	4.46		3.38	1.20	-2.76	-21.93
57	14.83	0.0	25.0	6.08	4.75	17.22	24.40	20.63	2.08	0.41	-0.09
63	14.81	0.0	25.0	7.93	4.78	11.47	15.20	11.86	1.30	-0.67	-12.04
67	14.83	0.0	25.0	9.92	5.41	7.84	11.60	7.44	1.04	-1.59	-19.77
71	14.84	0.0	25.0	11.92	6.30	5.80	7.50	5.00	1.02	-2.40	-24.28
107	14.82	0.0	30.0	5.98	7.21	20.21		24.97	4.06	0.93	7.07
111	14.84	0.0	30.0	6.98	5.94	17.27		20.32	2.27	0.43	0.08
115	14.81	0.0	30.0	7.94	5.98	14.59		16.12	1.80	-0.09	-6.60
119	14.81	0.0	30.0	8.92	6.21	12.74		12.79	1.50	-0.61	-12.53
123	14.82	0.0	30.0	9.89	6.58	10.34		10.16	1.35	-1.12	-17.35
127	14.79	0.0	30.0	10.86	6.92	8.80		8.14	1.17	-1.60	-21.30
131	14	0.0	30.0	11.80	7.35	7.63		6.76	1.08	-2.02	-24.36
5	14	0.0	35.0	6.06	11.41	21.67	29.40	27.62	7.70	1.48	11.86
10	14.	0.0	35.0	8.01	7.15	16.71	24.40	19.42	2.22	0.37	-1.41
14	14.	0.0	35.0	9.98	7.77	12.57	17.40	13.43	1.61	-0.56	-13.62
18	14.8	0.0	35.0	11.91	8.60	9.29	13.40	9.04	1.21	-1.56	-23.42
157	14.80	0.0	40.0	9.91	8.88	14.26		15.82	1.89	-0.15	-9.80
156	14.83	0.0	40.0	11.92	9.87	10.84		11.06	1.42	-1.15	-21.48
209	14.78	0.0	45.0	9.96	10.31	16.39		19.61	2.41	0.40	-2.94
208	14.80	0.0	45.0	11.94	11.25	12.76		13.75	1.73	-0.59	-16.80
210	14.82	0.0	50.0	10.01	12.42	17.84		21.83	3.60	0.89	7.66
158	14.82	0.0	50.0	10.03	12.31	17.69		21.74	3.47	0.88	1.97
159	14.82	0.0	50.0	11.92	12.64	14.26		16.02	2.09	-0.13	-12.36
211	14.81	0.0	50.0	11.99	12.78	14.45		16.07	2.16	-0.11	-11.48
213	14.81	0.0	55.0	10.09	15.71	19.19		24.22	5.92	1.45	8.80
160	14.82	0.0	55.0	11.96	14.15	15.67		18.36	2.50	0.36	-6.97
212	14.82	0.0	55.0	12.01	14.24	15.85		18.52	2.54	0.40	-6.04
161	14.82	0.0	60.0	12.04	16.16	16.97		20.63	3.36	0.84	-1.10
147	14.85	2.0	35.0	7.94	6.79	13.23		15.55	1.91	-0.16	-11.68
148	14.79	4.0	35.0	7.88	6.77	10.21		11.38	1.92	-0.74	-20.63
75	14.80	5.0	25.0	5.87	4.35	7.09	10.30	7.01	1.78	-1.00	-21.38
79	14.83	5.0	25.0	7.91	5.34	5.20	7.70	5.80	1.87	-1.78	-25.57
83	14.80	5.0	25.0	9.88	6.62	4.30	6.20	3.38	2.27	-2.45	-27.87
87	14.82	5.0	25.0	11.93	8.41	3.85	4.90	1.88	3.13	-3.05	-29.54
22	14.82	5.0	35.0	5.90	6.20	13.11	22.90	18.14	2.58	0.14	-12.17
26	14.81	5.0	35.0	7.79	6.86	9.20	14.40	10.07	2.07	-0.91	-23.67
31	14.82	5.0	35.0	9.82	8.02	6.82	10.20	6.35	1.96	-1.78	-30.91
35	14.82	5.0	35.0	11.86	9.58	5.52	7.90	4.17	2.24	-2.56	-35.23
149	14.79	6.0	35.0	7.85	6.98	7.85		7.47	2.16	-1.27	-27.71
150	14.83	8.0	35.0	7.92	7.60	6.21		4.29	2.72	-1.72	-32.84
91	14.81	10.0	25.0	5.85	6.90	4.18	5.40	-0.30	4.34	-1.74	-28.52
95	14.81	10.0	25.0	7.87	8.33	3.62	4.40	-0.47	4.87	-2.36	-30.23
99	14.82	10.0	25.0	9.91	9.22	3.37	4.40	-0.43	4.86	-2.94	-31.10
103	14.81	10.0	25.0	11.98	10.21	3.04	3.90	-0.40	4.90	-3.53	-32.26
40	14.82	10.0	35.0	5.66	6.69	6.69	10.90	5.31	3.32	-1.13	-31.35
46	14.79	10.0	35.0	7.76	8.26	5.40	8.30	2.61	3.49	-1.91	-35.54
50	14.83	10.0	35.0	9.78	10.13	4.63	7.50	1.71	4.10	-2.54	-38.44
54	14.82	10.0	35.0	11.80	11.92	4.19	6.40	1.25	4.60	-3.14	-40.40
55	14.82	10.0	35.0	11.81	11.95	4.21	5.90	1.24	4.63	-3.15	-40.17

TABLE A2.1

LOW SPEED ROUGH WATER MODEL RESULTS
AT 31 lb (55,030 lb) AND ZERO FLAP

RUN DIRECTORY

Equivalent Ship Speed, mph	10.56 in. LCG	12.06 in. LCG
5	63	22
8		18
10	64	
11		21
14		17
15	65	
17		20

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 25-MAY-77

RUN 63

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 0.0 DEG
SPEED 2.12 FPS DRAG 0.82 LB CP 15.29 IN SKWL 31.81 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 112

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	3.757	85	6.80	9.20	11.21	12.80
		2.616		0.73	-1.17	-2.42	-3.58
HEAVE	IN	-0.120	72	0.69	1.05	1.34	1.55
		0.441		-0.52	-0.84	-1.00	-1.13
DRIVER STA		-0.009	80	0.19	0.29	0.46	0.64
ACCEL	G	0.129		-0.23	-0.33	-0.40	-0.45
FWD TROOP		-0.012	67	0.17	0.24	0.38	0.48
ACCEL	G	0.102		-0.20	-0.28	-0.33	-0.37
CG		-0.003	51	0.13	0.18	0.24	0.29
ACCEL	G	0.071		-0.16	-0.21	-0.24	-0.25
AFT TROOP		-0.009	44	0.10	0.13	0.15	0.16
ACCEL	G	0.050		-0.12	-0.15	-0.17	-0.20

FROUDE SCALE DATA
SPEED 5.0 MPH LOAD 55030. LB DRAG 1456. EHP 19.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 25-MAY-77

RUN 64

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 0.0 DEG
SPEED 4.23 FPS DRAG 2.94 LB CP 15.50 IN SKWL 31.65 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 77

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.223	52	6.65	8.26	9.40	10.01
		2.092		1.75	-0.01	-1.11	-1.94
HEAVE	IN	-0.017	42	0.61	1.01	1.30	1.50
		0.452		-0.62	-0.91	-1.12	-1.25
DRIVER STA		-0.008	53	0.23	0.33	0.43	0.58
ACCEL	G	0.150		-0.23	-0.35	-0.42	-0.48
FWD TROOP		-0.011	46	0.19	0.27	0.34	0.41
ACCEL	G	0.123		-0.21	-0.31	-0.37	-0.41
CG		-0.003	38	0.16	0.21	0.25	0.27
ACCEL	G	0.098		-0.19	-0.26	-0.31	-0.35
AFT TROOP		-0.007	44	0.14	0.20	0.26	0.29
ACCEL	G	0.098		-0.17	-0.26	-0.30	-0.33

FROUDE SCALE DATA
SPEED 10.0 MPH LOAD 55030. LB DRAG 5214. EHP 139.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 25-MAY-77

RUN 65

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 0.0 DEG
SPEED 6.36 FPS DRAG 7.43 LB CP 15.81 IN SKWL 30.42 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 60

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	6.960	35	9.09	10.33	10.98	11.30
		1.587		4.83	3.77	3.08	2.75
HEAVE	IN	0.348	32	0.88	1.19	1.32	1.39
		0.379		-0.15	-0.39	-0.53	-0.61
DRIVER STA		-0.011	45	0.27	0.42	0.51	0.62
ACCEL	G	0.168		-0.24	-0.38	-0.48	-0.54
FWD TROOP		-0.011	39	0.23	0.35	0.41	0.48
ACCEL	G	0.137		-0.22	-0.34	-0.41	-0.46
CG		-0.001	33	0.19	0.26	0.29	0.32
ACCEL	G	0.108		-0.19	-0.28	-0.32	-0.36
AFT TROOP		-0.007	33	0.14	0.21	0.24	0.25
ACCEL	G	0.093		-0.16	-0.23	-0.27	-0.29

FROUDE SCALE DATA
SPEED 15.0 MPH LOAD 55030. LB DRAG 13181. EHP 528.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 22

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 2.12 FPS DRAG 0.63 LB CP 17.13 IN SKWL ***** IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 112

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	-1.065	85	1.85	3.92	5.78	7.30
		2.462		-4.22	-5.74	-6.47	-6.70
HEAVE	IN	0.150	71	0.66	0.88	1.04	1.25
		0.345		-0.32	-0.51	-0.59	-0.66
DRIVER STA		0.030	79	0.27	0.44	0.61	0.73
ACCEL	G	0.109		-0.14	-0.21	-0.29	-0.35
FWD TROOP		-0.010	59	0.19	0.33	0.44	0.50
ACCEL	G	0.083		-0.16	-0.21	-0.25	-0.27
CG		-0.001	35	0.14	0.19	0.23	0.26
ACCEL	G	0.056		-0.13	-0.16	-0.18	-0.20
AFT TROOP		-0.004	56	0.10	0.13	0.15	0.19
ACCEL	G	0.064		-0.16	-0.26	-0.32	-0.35

FROUDE SCALE DATA
SPEED 5.0 MPH LOAD 55030. LB DRAG 1126. EHP 15.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 18

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 3.39 FPS DRAG 1.44 LB CP 17.28 IN SKWL ***** IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 80

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	-1.894	60	0.50	2.52	3.47	5.37
		2.042		-4.54	-5.63	-6.19	-7.06
HEAVE	IN	0.040	52	0.53	0.78	0.94	1.26
		0.341		-0.42	-0.53	-0.61	-0.68
DRIVER STA		-0.006	51	0.26	0.44	0.55	0.75
ACCEL	G	0.117		-0.20	-0.27	-0.32	-0.34
FWD TROOP		-0.012	46	0.20	0.33	0.41	0.55
ACCEL	G	0.094		-0.18	-0.24	-0.28	-0.29
CG		-0.001	33	0.14	0.18	0.21	0.26
ACCEL	G	0.070		-0.15	-0.20	-0.22	-0.22
AFT TROOP		-0.006	50	0.12	0.16	0.18	0.19
ACCEL	G	0.085		-0.17	-0.26	-0.34	-0.47

FROUDE SCALE DATA

SPEED 8.0 MPH LOAD 55030. LB DRAG 2551. EHP 55.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 21

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 4.67 FPS DRAG 3.16 LB CP 17.35 IN SKWL ***** IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 68

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	-0.182	46	2.06	3.66	5.38	6.88
		1.930		-2.51	-3.72	-4.34	-4.78
HEAVE	IN	-0.350	38	0.22	0.52	0.74	0.93
		0.416		-0.92	-1.14	-1.19	-1.24
DRIVER STA		0.118	44	0.34	0.49	0.62	0.69
ACCEL	G	0.151		-0.08	-0.20	-0.26	-0.33
FWD TROOP		-0.012	36	0.19	0.29	0.41	0.42
ACCEL	G	0.105		-0.19	-0.24	-0.29	-0.33
CG		-0.003	30	0.16	0.21	0.24	0.27
ACCEL	G	0.089		-0.17	-0.21	-0.25	-0.27
AFT TROOP		-0.005	40	0.16	0.22	0.26	0.27
ACCEL	G	0.110		-0.19	-0.25	-0.30	-0.31

FROUDE SCALE DATA
SPEED 11.0 MPH LOAD 55030. LB DRAG 5601. EHP 165.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 17

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 5.94 FPS DRAG 6.03 LB CP 17.50 IN SKWL 32.57 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 62

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.010	38	3.98	5.15	5.80	5.93
		1.551		0.01	-1.14	-2.13	-2.76
HEAVE	IN	-0.252	32	0.28	0.58	0.73	0.91
		0.390		-0.76	-1.08	-1.30	-1.45
DRIVER STA		-0.005	37	0.21	0.30	0.41	0.47
ACCEL	G	0.129		-0.21	-0.30	-0.36	-0.39
FWD TROOP		-0.014	33	0.17	0.26	0.31	0.38
ACCEL	G	0.111		-0.21	-0.28	-0.32	-0.36
CG		-0.001	28	0.16	0.21	0.26	0.26
ACCEL	G	0.094		-0.17	-0.23	-0.27	-0.29
AFT TROOP		-0.000	32	0.16	0.22	0.27	0.29
ACCEL	G	0.104		-0.18	-0.26	-0.29	-0.33

FROUDE SCALE DATA
SPEED 14.0 MPH LOAD 55030. LB DRAG 10707. EHP 400.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 20

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 7.21 FPS DRAG 7.80 LB CP 17.49 IN SKWL 31.44 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 57

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.544	34	6.15	7.11	7.87	8.23
		1.271		2.90	2.03	1.59	1.45
HEAVE	IN	0.088	28	0.53	0.74	0.84	0.95
		0.314		-0.34	-0.56	-0.69	-0.76
DRIVER STA		-0.004	42	0.24	0.36	0.48	0.56
ACCEL	G	0.147		-0.21	-0.33	-0.38	-0.40
FWD TROOP		-0.012	37	0.20	0.29	0.38	0.44
ACCEL	G	0.124		-0.20	-0.29	-0.33	-0.36
CG		0.000	32	0.17	0.23	0.25	0.28
ACCEL	G	0.098		-0.17	-0.24	-0.27	-0.31
AFT TROOP		-0.005	30	0.14	0.20	0.23	0.24
ACCEL	G	0.090		-0.15	-0.21	-0.25	-0.26

FROUDE SCALE DATA
SPEED 17.0 MPH LOAD 55030. LB DRAG 13843. EHP 628.

TABLE A2.2

ROUGH WATER MODEL RESULTS

AT 8.47 fps (20 mph), 31 lb (55,030 lb)

RUN DIRECTORY

LCG, in.	9.06	10.56	12.06
Flap Angle degrees			
0	24	66	131
2		121	132
5	29	58	52
7		130	
10	34	61	
11		129	
13	36		
15	137		

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 24

LOAD 31.0 LB LCG 9.06 IN FLAP ANGLE 0.0 DEG
SPEED 8.48 FPS DRAG 9.60 LB CF 14.13 IN SKWL 21.76 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 57

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	14.897	34	16.72	17.99	18.97	19.68
		1.716		12.64	11.20	10.25	9.84
HEAVE	IN	2.106	29	2.70	3.09	3.31	3.37
		0.444		1.55	1.23	1.04	0.90
DRIVER STA		-0.091	51	0.50	0.92	1.20	1.38
ACCEL	G	0.321		-0.40	-0.62	-0.72	-0.78
FWD TROOP		-0.023	47	0.49	0.84	1.07	1.20
ACCEL	G	0.271		-0.31	-0.49	-0.59	-0.62
CG		0.001	46	0.35	0.56	0.70	0.78
ACCEL	G	0.207		-0.25	-0.39	-0.48	-0.52
AFT TROOP		-0.022	29	0.15	0.23	0.28	0.30
ACCEL	G	0.111		-0.20	-0.29	-0.32	-0.33

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 17047. EHP 910.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 29

LOAD 31.0 LB LCG 9.06 IN FLAP ANGLE 5.0 DEG
SPEED 8.47 FPS DRAG 8.64 LB CP 14.24 IN SKWL 24.55 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 53

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	11.063	35	13.02	14.31	14.97	15.25
		1.667		8.88	7.82	7.21	6.79
HEAVE	IN	1.882	29	2.45	2.76	3.02	3.13
		0.403		1.33	1.11	0.97	0.91
DRIVER STA		-0.014	52	0.50	0.83	1.07	1.28
ACCEL	G	0.302		-0.32	-0.52	-0.63	-0.78
FWD TROOP		-0.007	50	0.44	0.71	0.92	1.07
ACCEL	G	0.255		-0.28	-0.45	-0.56	-0.70
CG		-0.004	46	0.30	0.47	0.59	0.67
ACCEL	G	0.195		-0.26	-0.40	-0.49	-0.61
AFT TROOP		-0.006	33	0.18	0.25	0.30	0.38
ACCEL	G	0.120		-0.18	-0.26	-0.31	-0.39

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 15329. EHP 818.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 34

LOAD 31.0 LB LCG 9.06 IN FLAP ANGLE 10.0 DEG
SPEED 8.47 FPS DRAG 8.30 LB CP 14.48 IN SKWL 28.78 IN
SIGNIFICANT WAVE HEIGHT 0.00 IN WAVE ENCOUNTERS 52

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	6.641	35	8.47	9.48	9.99	10.43
		1.417		4.87	3.99	3.25	2.75
HEAVE	IN	1.509	27	2.01	2.17	2.28	2.35
		0.326		1.04	0.82	0.70	0.63
DRIVER STA		-0.005	48	0.39	0.62	0.80	1.00
ACCEL	G	0.242		-0.30	-0.48	-0.55	-0.61
FWD TROOP		-0.009	45	0.33	0.52	0.66	0.81
ACCEL	G	0.203		-0.27	-0.42	-0.49	-0.54
CG		-0.007	40	0.24	0.35	0.43	0.49
ACCEL	G	0.154		-0.25	-0.36	-0.41	-0.47
AFT TROOP		-0.000	34	0.18	0.24	0.29	0.34
ACCEL	G	0.109		-0.17	-0.24	-0.27	-0.29

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 14728. EHP 785.

LR - 1957

DAVIDSON LABORATORY MACDEC LV() 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 36

LOAD 31.0 LB LCG 9.06 IN FLAP ANGLE 13.0 DEG
SPEED 8.47 FPS DRAG 8.30 LB CP 14.62 IN SKWL 29.83 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 55

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.323	34	6.06	6.88	7.45	7.76
		1.378		2.46	1.50	0.93	0.73
HEAVE	IN	1.342	29	1.77	1.97	2.13	2.17
		0.312		0.92	0.73	0.59	0.47
DRIVER STA		-0.001	45	0.41	0.68	0.97	1.38
ACCEL	G	0.219		-0.27	-0.41	-0.49	-0.55
FWD TROOP		-0.003	45	0.34	0.56	0.80	1.17
ACCEL	G	0.184		-0.23	-0.35	-0.42	-0.47
CG		-0.007	39	0.24	0.38	0.50	0.70
ACCEL	G	0.139		-0.22	-0.32	-0.39	-0.42
AFT TROOP		0.006	30	0.18	0.25	0.29	0.29
ACCEL	G	0.108		-0.17	-0.24	-0.29	-0.32

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 14727. EHP 785.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 137

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 15.0 DEG
SPEED 8.47 FPS DRAG 8.16 LB CP 14.73 IN SKWL 30.42 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 53

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.721	32	4.40	5.36	6.00	6.17
		1.261		1.18	0.24	-0.78	-0.98
HEAVE	IN	1.354	24	1.82	2.07	2.21	2.29
		0.302		0.91	0.72	0.65	0.61
DRIVER STA		0.003	49	0.28	0.41	0.53	0.59
ACCEL	G	0.186		-0.25	-0.40	-0.51	-0.58
FWD TROOP		0.003	47	0.25	0.35	0.46	0.49
ACCEL	G	0.161		-0.23	-0.36	-0.44	-0.52
CG		-0.007	39	0.18	0.25	0.30	0.32
ACCEL	G	0.123		-0.21	-0.32	-0.38	-0.41
AFT TROOP		0.004	30	0.15	0.22	0.27	0.30
ACCEL	G	0.097		-0.17	-0.24	-0.30	-0.32

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 14487. EHP 773.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 25-MAY-77

RUN 66

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 0.0 DEG
SPEED 8.47 FPS DRAG 9.06 LB CP 15.70 IN SKWL 25.94 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 54

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	11.327	33	13.03	14.01	14.41	14.83
		1.427		9.28	8.14	7.46	6.67
HEAVE	IN	1.479	29	1.97	2.27	2.45	2.46
		0.365		0.99	0.76	0.58	0.45
DRIVER STA		-0.024	48	0.43	0.74	1.10	1.36
ACCEL	G	0.257		-0.32	-0.48	-0.56	-0.61
FWD TROOP		-0.019	47	0.37	0.61	0.89	1.12
ACCEL	G	0.211		-0.26	-0.40	-0.48	-0.53
CG		-0.004	42	0.27	0.42	0.56	0.72
ACCEL	G	0.163		-0.24	-0.35	-0.42	-0.46
AFT TROOP		-0.019	30	0.16	0.22	0.30	0.34
ACCEL	G	0.108		-0.18	-0.27	-0.30	-0.30

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 16076. EHP 858.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 121

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 2.0 DEG
SPEED 8.47 FPS DRAG 8.80 LB CP 15.78 IN SKWL 27.25 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 54

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.916	37	11.40	12.39	13.07	13.30
		1.302		8.27	7.06	6.43	6.16
HEAVE	IN	1.362	29	1.82	2.02	2.19	2.35
		0.341		0.90	0.60	0.41	0.34
DRIVER STA		-0.009	51	0.41	0.73	0.96	1.33
ACCEL	G	0.233		-0.26	-0.42	-0.49	-0.53
FWD TROOP		-0.005	49	0.36	0.61	0.83	1.12
ACCEL	G	0.195		-0.23	-0.35	-0.43	-0.47
CG		-0.004	43	0.25	0.41	0.52	0.65
ACCEL	G	0.150		-0.21	-0.32	-0.39	-0.42
AFT TROOP		-0.010	29	0.17	0.27	0.33	0.37
ACCEL	G	0.103		-0.17	-0.23	-0.26	-0.30

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 15622. EHP 834.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 58

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 5.0 DEG
SPEED 8.48 FPS DRAG 8.82 LB CP 15.96 IN SKWL 29.17 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 53

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.075	35	8.52	9.60	10.18	10.51
		1.240		5.51	4.37	3.79	2.84
HEAVE	IN	1.156	24	1.59	1.80	1.89	1.92
		0.302		0.69	0.42	0.32	0.20
DRIVER STA		-0.013	48	0.33	0.57	0.76	0.83
ACCEL	G	0.204		-0.26	-0.40	-0.48	-0.51
FWD TROOP		-0.009	46	0.29	0.47	0.62	0.66
ACCEL	G	0.171		-0.23	-0.34	-0.42	-0.43
CG		0.004	41	0.21	0.33	0.39	0.42
ACCEL	G	0.132		-0.20	-0.29	-0.34	-0.39
AFT TROOP		-0.004	29	0.16	0.25	0.29	0.29
ACCEL	G	0.097		-0.16	-0.22	-0.27	-0.29

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 15657. EHP 836.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 130

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 7.0 DEG
SPEED 8.47 FPS DRAG 8.59 LB CP 16.05 IN SKWL 29.84 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 52

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.621	31	7.20	7.99	8.45	8.83
		1.220		4.00	2.82	2.45	2.29
HEAVE	IN	1.043	27	1.47	1.69	1.77	1.83
		0.312		0.60	0.33	0.19	0.11
DRIVER STA		-0.002	50	0.28	0.46	0.62	0.75
ACCEL	G	0.184		-0.23	-0.36	-0.44	-0.46
FWD TROOP		-0.003	43	0.26	0.41	0.53	0.65
ACCEL	G	0.159		-0.22	-0.33	-0.39	-0.41
CG		0.057	38	0.26	0.35	0.43	0.52
ACCEL	G	0.126		-0.14	-0.22	-0.29	-0.31
AFT TROOP		-0.004	31	0.16	0.23	0.29	0.31
ACCEL	G	0.098		-0.15	-0.21	-0.25	-0.26

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 15241. EHP 813.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 61

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 10.0 DEG
SPEED 8.48 FPS DRAG 8.33 LB CP 16.22 IN SKWL 31.11 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 52

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.654	30	4.27	5.09	5.45	5.75
		1.171		1.02	0.23	-0.27	-0.38
HEAVE	IN	0.865	25	1.26	1.45	1.58	1.71
		0.282		0.47	0.25	0.12	0.04
DRIVER STA		-0.021	44	0.25	0.38	0.49	0.64
ACCEL	G	0.172		-0.27	-0.40	-0.49	-0.57
FWD TROOP		-0.011	41	0.22	0.32	0.41	0.53
ACCEL	G	0.142		-0.23	-0.34	-0.41	-0.48
CG		-0.001	36	0.18	0.25	0.30	0.35
ACCEL	G	0.110		-0.20	-0.29	-0.33	-0.39
AFT TROOP		-0.007	31	0.14	0.20	0.24	0.26
ACCEL	G	0.093		-0.17	-0.23	-0.26	-0.28

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 14782. EHP 789.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 129

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 11.0 DEG
SPEED 8.47 FPS DRAG 8.15 LB CP 16.27 IN SKWL 31.34 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 54

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	1.917	34	3.24	4.10	4.76	5.48
		1.128		0.42	-0.56	-1.39	-1.61
HEAVE	IN	0.847	22	1.29	1.48	1.60	1.62
		0.289		0.43	0.22	0.01	-0.12
DRIVER STA		-0.002	46	0.24	0.37	0.46	0.55
ACCEL	G	0.157		-0.21	-0.32	-0.40	-0.48
FWD TROOP		0.003	41	0.22	0.33	0.39	0.48
ACCEL	G	0.135		-0.19	-0.28	-0.34	-0.41
CG		-0.007	32	0.17	0.24	0.27	0.34
ACCEL	G	0.106		-0.19	-0.27	-0.31	-0.35
AFT TROOP		0.003	33	0.15	0.22	0.27	0.31
ACCEL	G	0.095		-0.14	-0.21	-0.26	-0.32

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 14469. EHP 772.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 131

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 0.0 DEG
SPEED 8.48 FPS DRAG 9.33 LB CP 17.48 IN SKWL 29.87 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 53

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.137	35	8.46	9.48	10.09	10.72
		1.119		5.70	4.67	3.98	3.43
HEAVE	IN	0.677	22	1.14	1.36	1.47	1.56
		0.303		0.21	-0.04	-0.22	-0.46
DRIVER STA		-0.014	48	0.25	0.41	0.54	0.62
ACCEL	G	0.171		-0.24	-0.37	-0.46	-0.48
FWD TROOP		-0.004	44	0.23	0.37	0.46	0.53
ACCEL	G	0.148		-0.21	-0.32	-0.40	-0.42
CG		-0.118	34	0.07	0.16	0.22	0.28
ACCEL	G	0.120		-0.31	-0.40	-0.47	-0.50
AFT TROOP		-0.020	29	0.12	0.19	0.26	0.28
ACCEL	G	0.089		-0.16	-0.23	-0.28	-0.28

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 16558. EHP 884.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 132

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 2.0 DEG
SPEED 8.47 FPS DRAG 9.16 LB CP 17.58 IN SKWL 30.57 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 56

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.555	33	6.79	7.51	7.89	8.81
		1.057		4.19	3.04	2.61	2.50
HEAVE	IN	0.585	24	1.01	1.22	1.31	1.35
		0.288		0.17	-0.07	-0.18	-0.22
DRIVER STA		-0.003	44	0.25	0.40	0.49	0.61
ACCEL	G	0.155		-0.21	-0.32	-0.39	-0.45
FWD TROOP		-0.001	38	0.23	0.35	0.43	0.52
ACCEL	G	0.134		-0.20	-0.29	-0.35	-0.39
CG		0.020	33	0.20	0.28	0.31	0.33
ACCEL	G	0.107		-0.16	-0.23	-0.27	-0.33
AFT TROOP		-0.005	28	0.14	0.21	0.26	0.28
ACCEL	G	0.087		-0.15	-0.20	-0.23	-0.26

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 16256. EHP 868.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 52

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 5.0 DEG
SPEED 8.47 FPS DRAG 8.58 LB CP 17.74 IN SKWL 31.62 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 56

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.501	33	3.95	4.76	5.18	5.49
		1.122		1.15	0.20	-0.50	-1.22
HEAVE	IN	0.448	24	0.86	1.07	1.19	1.27
		0.285		0.03	-0.15	-0.23	-0.29
DRIVER STA		-0.007	42	0.24	0.35	0.43	0.51
ACCEL	G	0.158		-0.23	-0.35	-0.43	-0.45
FWD TROOP		-0.010	39	0.20	0.29	0.36	0.40
ACCEL	G	0.132		-0.21	-0.31	-0.38	-0.41
CG		-0.004	32	0.17	0.23	0.26	0.30
ACCEL	G	0.105		-0.19	-0.27	-0.33	-0.35
AFT TROOP		-0.004	30	0.13	0.19	0.22	0.24
ACCEL	G	0.092		-0.16	-0.23	-0.28	-0.32

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 55030. LB DRAG 15225. EHP 812.

TABLE A2.3

ROUGH WATER MODEL RESULTS

AT 10.58 fps (25 mph), 31 lb (55,030 lb)

RUN DIRECTORY

LCG, In.	9.06	10.56	12.06
Flap Angle degrees			
0	138	67	15
1			135
2	140	122	133
3		127	
5	30	59	53
7	142	126	
10	144	62	
13	146		

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 138

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 0.0 DEG
SPEED 10.58 FPS DRAG 8.69 LB CP 14.11 IN SKWL 17.02 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 49

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	13.589	31	15.52	17.16	18.14	18.76
		1.861		11.30	9.63	8.64	8.08
HEAVE	IN	3.345	26	3.98	4.51	4.75	4.89
		0.504		2.69	2.33	2.13	1.96
DRIVER STA		-0.011	45	0.85	1.70	2.31	2.77
ACCEL	G	0.422		-0.39	-0.61	-0.75	-0.84
FWD TROOP		-0.003	45	0.79	1.58	2.15	2.59
ACCEL	G	0.379		-0.35	-0.55	-0.68	-0.77
CG		0.002	44	0.56	1.11	1.52	1.85
ACCEL	G	0.289		-0.31	-0.49	-0.62	-0.69
AFT TROOP		-0.003	34	0.21	0.33	0.37	0.38
ACCEL	G	0.137		-0.20	-0.30	-0.40	-0.45

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 15428. EHP 1028.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 140

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 2.0 DEG
SPEED 10.59 FPS DRAG 7.95 LB CP 14.13 IN SKWL 17.96 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 54

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	11.908	31	13.94	15.59	16.65	17.52
		1.895		9.51	7.80	6.84	6.40
HEAVE	IN	3.173	27	3.78	4.31	4.56	4.70
		0.501		2.53	2.17	1.96	1.87
DRIVER STA		-0.014	52	0.79	1.56	2.23	2.95
ACCEL	G	0.435		-0.37	-0.61	-0.74	-0.87
FWD TROOP		-0.002	52	0.73	1.43	2.09	2.71
ACCEL	G	0.388		-0.32	-0.54	-0.67	-0.80
CG		0.004	44	0.55	1.03	1.56	1.90
ACCEL	G	0.293		-0.32	-0.49	-0.61	-0.72
AFT TROOP		-0.017	34	0.20	0.34	0.40	0.43
ACCEL	G	0.146		-0.21	-0.32	-0.42	-0.49

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 14115. EHP 941.

LR - 1957

DAVIDSON LABORATURY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 30

LOAD 31.0 LB LCG 9.06 IN FLAP ANGLE 5.0 DEG
SPEED 10.59 FPS DRAG 7.55 LB CP 14.19 IN SKWL 20.94 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.726	32	11.61	12.75	13.72	14.24
		1.747		7.43	5.73	4.75	3.84
HEAVE	IN	2.732	26	3.31	3.66	3.93	4.17
		0.443		2.14	1.84	1.65	1.61
DRIVER STA		-0.010	52	0.88	1.70	2.65	3.80
ACCEL	G	0.460		-0.37	-0.61	-0.73	-0.78
FWD TROOP		-0.003	52	0.76	1.45	2.27	3.29
ACCEL	G	0.393		-0.32	-0.54	-0.65	-0.70
CG		-0.003	49	0.54	1.01	1.67	2.25
ACCEL	G	0.293		-0.29	-0.47	-0.56	-0.60
AFT TROOP		-0.005	31	0.23	0.36	0.43	0.47
ACCEL	G	0.151		-0.22	-0.32	-0.39	-0.41

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 13401. EHP 894.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 142

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 7.0 DEG
SPEED 10.59 FPS DRAG 7.39 LB CP 14.29 IN SKWL 21.82 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 48

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	0.146	34	9.99	11.29	12.22	12.55
		1.668		6.03	4.97	4.11	3.22
HEAVE	IN	2.730	29	3.27	3.60	3.91	4.02
		0.414		2.20	1.89	1.71	1.69
DRIVER STA		0.001	51	0.71	1.23	1.63	2.51
ACCEL	G	0.398		-0.36	-0.60	-0.72	-0.78
FWD TROOP		0.005	50	0.65	1.11	1.56	2.34
ACCEL	G	0.351		-0.33	-0.54	-0.67	-0.71
CG		0.000	47	0.45	0.75	1.01	1.52
ACCEL	G	0.260		-0.29	-0.46	-0.56	-0.62
AFT TROOP		0.002	35	0.23	0.34	0.41	0.48
ACCEL	G	0.151		-0.21	-0.30	-0.36	-0.43

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 13124. EHP 875.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 144

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 10.0 DEG
SPEED 10.59 FPS DRAG 7.96 LB CP 14.53 IN SKWL 26.29 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 50

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.543	37	7.22	8.32	9.03	9.50
		1.457		3.80	2.71	1.35	0.10
HEAVE	IN	2.365	29	2.82	3.14	3.42	3.65
		0.351		1.94	1.68	1.40	1.29
DRIVER STA		0.004	53	0.58	0.97	1.26	1.41
ACCEL	G	0.337		-0.32	-0.53	-0.66	-0.78
FWD TROOP		0.005	52	0.52	0.85	1.10	1.22
ACCEL	G	0.293		-0.28	-0.47	-0.59	-0.70
CG		0.002	48	0.36	0.55	0.71	0.77
ACCEL	G	0.216		-0.25	-0.43	-0.54	-0.60
AFT TROOP		0.002	34	0.22	0.31	0.44	0.52
ACCEL	G	0.143		-0.20	-0.29	-0.36	-0.43

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 14125. EHP 942.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 146

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 13.0 DEG
SPEED 10.59 FPS DRAG 9.37 LB CP 14.89 IN SKWL 29.65 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 53

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.425	37	3.75	4.82	5.23	5.45
		1.215		0.98	-0.01	-0.82	-0.93
HEAVE	IN	1.877	23	2.28	2.53	2.62	2.66
		0.296		1.43	1.24	1.09	0.94
DRIVER STA		0.009	53	0.38	0.63	0.83	1.12
ACCEL	G	0.257		-0.30	-0.49	-0.62	-0.68
FWD TROOP		0.007	52	0.34	0.55	0.71	0.98
ACCEL	G	0.222		-0.26	-0.43	-0.54	-0.59
CG		-0.005	42	0.24	0.39	0.47	0.57
ACCEL	G	0.165		-0.25	-0.37	-0.45	-0.47
AFT TROOP		0.007	36	0.19	0.30	0.37	0.40
ACCEL	G	0.125		-0.18	-0.27	-0.33	-0.36

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 16624. EHP 1108.

SQRT ERROR AT LOC 25466

82

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 25-MAY-77

RUN 67

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 0.0 DEG
SPEED 10.59 FPS DRAG 8.36 LB CP 15.57 IN SKWL 20.30 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 50

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	11.954	29	13.87	15.22	15.83	16.56
		1.621		9.74	8.71	8.02	7.83
HEAVE	IN	2.688	26	3.24	3.59	3.80	4.10
		0.436		2.11	1.85	1.77	1.75
DRIVER STA		-0.022	50	0.65	1.22	1.61	1.95
ACCEL	G	0.390		-0.42	-0.62	-0.76	-0.81
FWD TROOP		-0.023	47	0.57	1.02	1.33	1.66
ACCEL	G	0.326		-0.37	-0.55	-0.67	-0.71
CG		0.001	46	0.42	0.71	0.92	1.18
ACCEL	G	0.249		-0.28	-0.43	-0.53	-0.58
AFT TROOP		-0.023	31	0.19	0.29	0.32	0.34
ACCEL	G	0.134		-0.21	-0.32	-0.38	-0.44

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 14835. EHP 989.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 122

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 2.0 DEG
SPEED 10.59 FPS DRAG 7.92 LB CP 15.66 IN SKWL 22.10 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 52

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	10.282	34	11.88	13.25	14.00	14.67
		1.547		8.44	7.13	6.38	5.60
HEAVE	IN	2.481	24	3.08	3.46	3.60	3.66
		0.414		1.91	1.67	1.46	1.31
DRIVER STA		-0.018	52	0.61	1.02	1.45	2.04
ACCEL	G	0.350		-0.33	-0.55	-0.68	-0.76
FWD TROOP		-0.011	51	0.55	0.93	1.30	1.83
ACCEL	G	0.309		-0.30	-0.50	-0.62	-0.69
CG		0.004	47	0.40	0.64	0.90	1.20
ACCEL	G	0.234		-0.25	-0.43	-0.53	-0.65
AFT TROOP		-0.026	31	0.18	0.28	0.38	0.44
ACCEL	G	0.136		-0.22	-0.32	-0.38	-0.39

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 14056. EHP 937.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 127

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 3.0 DEG
SPEED 10.59 FPS DRAG 7.82 LB CP 15.70 IN SKWL 23.07 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 48

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.493	35	10.98	12.05	12.87	13.28
		1.483		7.70	6.30	5.45	4.94
HEAVE	IN	2.398	27	2.92	3.28	3.45	3.55
		0.400		1.88	1.56	1.41	1.32
DRIVER STA		-0.008	49	0.64	1.06	1.48	1.84
ACCEL	G	0.343		-0.33	-0.54	-0.63	-0.68
FWD TROOP		-0.006	49	0.57	0.95	1.32	1.66
ACCEL	G	0.302		-0.30	-0.49	-0.58	-0.63
CG		0.091	45	0.48	0.72	0.93	1.16
ACCEL	G	0.229		-0.18	-0.35	-0.42	-0.50
AFT TROOP		-0.007	34	0.20	0.30	0.39	0.48
ACCEL	G	0.137		-0.20	-0.30	-0.34	-0.40

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 13875. EHP 925.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 59

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 5.0 DEG
SPEED 10.59 FPS DRAG 8.22 LB CP 15.86 IN SKWL 25.96 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 52

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.536	33	9.19	10.23	10.69	10.85
		1.417		5.75	4.50	3.51	2.11
HEAVE	IN	2.096	25	2.57	2.82	2.96	3.20
		0.348		1.62	1.37	1.21	1.06
DRIVER STA		-0.012	51	0.51	0.92	1.33	1.66
ACCEL	G	0.320		-0.32	-0.53	-0.61	-0.70
FWD TROOP		-0.011	50	0.44	0.78	1.18	1.42
ACCEL	G	0.271		-0.28	-0.46	-0.56	-0.64
CG		0.002	43	0.33	0.55	0.77	0.88
ACCEL	G	0.206		-0.25	-0.40	-0.48	-0.55
AFT TROOP		-0.015	31	0.20	0.31	0.40	0.48
ACCEL	G	0.139		-0.21	-0.29	-0.35	-0.41

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 14595. EHP 974.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 126

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 7.0 DEG
SPEED 10.59 FPS DRAG 8.55 LB CP 16.02 IN SKWL 27.52 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 54

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	6.036	36	7.42	8.66	9.35	9.74
		1.294		4.47	3.50	2.74	2.02
HEAVE	IN	2.000	25	2.47	2.73	2.85	3.02
		0.330		1.56	1.34	1.08	0.90
DRIVER STA		-0.007	53	0.44	0.71	0.93	1.11
ACCEL	G	0.280		-0.30	-0.51	-0.63	-0.71
FWD TROOP		0.000	50	0.41	0.64	0.83	0.96
ACCEL	G	0.244		-0.27	-0.45	-0.58	-0.64
CG		0.003	42	0.29	0.43	0.52	0.56
ACCEL	G	0.187		-0.25	-0.41	-0.50	-0.55
AFT TROOP		-0.005	31	0.19	0.27	0.34	0.41
ACCEL	G	0.132		-0.20	-0.29	-0.34	-0.36

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 15175. EHP 1012.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 62

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 10.0 DEG
SPEED 10.59 FPS DRAG 10.04 LB CP 16.43 IN SKWL 30.54 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 48

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.276	34	3.51	4.31	4.69	4.93
		1.061		1.05	0.00	-0.74	-1.17
HEAVE	IN	1.384	20	1.80	2.01	2.21	2.27
		0.274		0.99	0.82	0.73	0.66
DRIVER STA		-0.008	48	0.31	0.52	0.76	1.22
ACCEL	G	0.228		-0.29	-0.48	-0.66	-0.74
FWD TROOP		-0.009	45	0.26	0.42	0.59	0.93
ACCEL	G	0.186		-0.26	-0.41	-0.57	-0.63
CG		0.000	35	0.21	0.31	0.38	0.50
ACCEL	G	0.140		-0.23	-0.36	-0.46	-0.52
AFT TROOP		-0.007	29	0.16	0.23	0.29	0.31
ACCEL	G	0.111		-0.20	-0.30	-0.41	-0.44

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 17825. EHP 1189.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 20-MAY-77

RUN 15

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 10.59 FPS DRAG 8.63 LB CP 17.15 IN SKWL 24.45 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 49

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	10.215	35	11.75	13.04	13.60	14.12
		1.470		8.39	7.57	7.35	7.11
HEAVE	IN	2.025	24	2.59	2.89	3.04	3.06
		0.380		1.51	1.32	1.21	1.11
DRIVER STA		-0.032	49	0.54	0.99	1.42	1.90
ACCEL	G	0.321		-0.36	-0.57	-0.69	-0.79
FWD TROOP		-0.025	48	0.46	0.85	1.19	1.60
ACCEL	G	0.271		-0.31	-0.50	-0.60	-0.69
CG		-0.006	40	0.35	0.57	0.75	0.92
ACCEL	G	0.208		-0.28	-0.43	-0.55	-0.64
AFT TROOP		-0.015	30	0.20	0.31	0.37	0.39
ACCEL	G	0.132		-0.22	-0.30	-0.37	-0.38

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 15325. EHP 1022.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 135

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 1.0 DEG
SPEED 10.59 FPS DRAG 8.80 LB CP 17.27 IN SKWL 25.46 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 52

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.189	30	10.84	11.75	12.33	12.37
		1.263		7.39	6.44	5.84	5.68
HEAVE	IN	1.938	26	2.37	2.63	2.81	2.85
		0.338		1.46	1.26	1.15	0.98
DRIVER STA		-0.014	49	0.50	0.89	1.24	1.49
ACCEL	G	0.277		-0.29	-0.42	-0.52	-0.58
FWD TROOP		-0.007	48	0.46	0.81	1.11	1.34
ACCEL	G	0.242		-0.24	-0.37	-0.46	-0.51
CG		-0.006	39	0.34	0.53	0.70	0.81
ACCEL	G	0.187		-0.25	-0.38	-0.47	-0.53
AFT TROOP		-0.013	29	0.19	0.26	0.32	0.37
ACCEL	G	0.122		-0.19	-0.24	-0.28	-0.31

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 15616. EHP 1041.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 133

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 2.0 DEG
SPEED 10.58 FPS DRAG 8.78 LB CP 17.34 IN SKWL 26.96 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 53

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	8.117	36	9.49	10.40	11.07	11.48
		1.188		6.69	5.74	4.94	4.26
HEAVE	IN	1.790	25	2.24	2.50	2.68	2.78
		0.327		1.33	1.11	1.02	0.98
DRIVER STA		-0.007	42	0.46	0.79	1.08	1.63
ACCEL	G	0.259		-0.29	-0.45	-0.60	-0.70
FWD TROOP		-0.004	42	0.41	0.69	0.95	1.42
ACCEL	G	0.227		-0.25	-0.41	-0.54	-0.63
CG		-0.003	37	0.28	0.44	0.61	0.81
ACCEL	G	0.173		-0.24	-0.36	-0.49	-0.61
AFT TROOP		-0.006	30	0.18	0.29	0.36	0.40
ACCEL	G	0.120		-0.17	-0.26	-0.32	-0.36

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 15585. EHP 1038.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 53

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 5.0 DEG
SPEED 10.59 FPS DRAG 10.14 LB CP 17.67 IN SKWL 29.33 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 49

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.465	30	6.93	7.74	7.94	7.99
		1.100		4.05	3.14	2.72	2.55
HEAVE	IN	1.403	23	1.83	2.04	2.14	2.19
		0.298		0.99	0.79	0.70	0.66
DRIVER STA		-0.010	42	0.37	0.55	0.66	0.83
ACCEL	G	0.234		-0.31	-0.49	-0.58	-0.70
FWD TROOP		-0.010	39	0.32	0.46	0.55	0.67
ACCEL	G	0.197		-0.27	-0.43	-0.51	-0.60
CG		-0.002	37	0.24	0.32	0.38	0.44
ACCEL	G	0.155		-0.23	-0.37	-0.44	-0.50
AFT TROOP		-0.007	29	0.18	0.26	0.30	0.32
ACCEL	G	0.115		-0.19	-0.27	-0.30	-0.32

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 55030. LB DRAG 17996. EHP 1200.

TABLE A2.4

ROUGH WATER MODEL RESULTS

AT 12.7 fps (30 mph), 31 lb (55,030 lb)

RUN DIRECTORY

LCG, in	9.06	10.56	12.06
Flap Angle degrees			
0	139	68	51
2	141	123	134
3		128	
4			136
5	32	60	54
7	143	125	
10	145	124	
11	147		
12	148		

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 139

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 0.0 DEG
SPEED 12.71 FPS DRAG 7.28 LB CP 14.10 IN SKWL 14.36 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	10.982	25	13.49	15.20	16.74	16.84
		2.208		8.27	6.44	5.24	4.76
HEAVE	IN	3.885	20	4.70	5.32	5.71	5.95
		0.587		3.16	2.87	2.64	2.53
DRIVER STA		-0.009	57	1.09	2.16	3.57	4.74
ACCEL	G	0.587		-0.32	-0.67	-0.83	-0.90
FWD TROOP		0.000	58	1.03	2.00	3.44	4.78
ACCEL	G	0.541		-0.31	-0.60	-0.76	-0.84
CG		-0.002	55	0.78	1.53	2.58	3.80
ACCEL	G	0.418		-0.30	-0.55	-0.72	-0.81
AFT TROOP		-0.011	51	0.29	0.57	0.98	1.92
ACCEL	G	0.205		-0.24	-0.42	-0.59	-0.94

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 12931. EHP 1035.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 141

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 2.0 DEG
SPEED 12.71 FPS DRAG 6.85 LB CP 14.15 IN SKWL 18.26 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 48

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.361	28	11.50	13.11	14.43	14.95
		2.001		6.86	5.09	3.75	3.69
HEAVE	IN	3.195	24	3.87	4.33	4.84	5.10
		0.523		2.57	2.24	2.07	1.93
DRIVER STA		-0.010	57	1.09	2.32	3.90	4.90
ACCEL	G	0.595		-0.36	-0.67	-0.80	-0.93
FWD TROOP		-0.001	59	-1.00	2.13	3.77	4.70
ACCEL	G	0.546		-0.34	-0.62	-0.76	-0.85
CG		-0.005	56	0.75	1.59	2.79	3.41
ACCEL	G	0.414		-0.31	-0.58	-0.71	-0.79
AFT TROOP		-0.009	48	0.25	0.53	0.84	1.33
ACCEL	G	0.192		-0.25	-0.42	-0.54	-0.66

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 12158. EHP 973.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 32

LOAD 31.0 LB LCG 9.06 IN FLAP ANGLE 5.0 DEG
SPEED 12.71 FPS DRAG 6.42 LB CF 14.23 IN SKWL 10.70 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 49

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.096	30	8.96	10.65	11.64	12.56
		1.838		4.62	3.29	1.96	1.74
HEAVE	IN	3.211	26	3.76	4.23	4.58	4.97
		0.469		2.66	2.40	2.33	2.30
DRIVER STA		0.004	58	1.10	2.10	3.38	4.77
ACCEL	G	0.583		-0.36	-0.70	-0.87	-0.97
FWD TROOP		0.000	59	0.94	1.82	2.96	4.26
ACCEL	G	0.505		-0.31	-0.63	-0.80	-0.90
CG		-0.002	57	0.68	1.32	2.13	3.18
ACCEL	G	0.379		-0.29	-0.56	-0.69	-0.78
AFT TROOP		0.002	40	0.27	0.42	0.52	0.66
ACCEL	G	0.188		-0.26	-0.39	-0.50	-0.54

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 11397. EHP 913.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 4/12 - SCALE MODEL DATA 5-JUL-77

RUN 143

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 7.0 DEG
SPEED 12.71 FPS DRAG 6.65 LB CP 14.36 IN SKWL 20.76 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 51

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.700	37	7.44	8.81	10.04	11.11
		1.736		3.74	2.06	0.50	-0.15
HEAVE	IN	3.057	23	3.67	3.98	4.31	4.41
		0.427		2.50	2.19	2.05	2.00
DRIVER STA		-0.002	59	1.00	2.03	3.24	3.85
ACCEL	G	0.552		-0.37	-0.70	-0.83	-0.90
FWD TROOP		0.001	63	0.88	1.82	2.90	3.57
ACCEL	G	0.496		-0.31	-0.63	-0.74	-0.83
CG		-0.000	62	0.61	1.23	1.98	2.45
ACCEL	G	0.361		-0.27	-0.57	-0.68	-0.80
AFT TROOP		0.001	36	0.23	0.41	0.55	0.62
ACCEL	G	0.192		-0.27	-0.43	-0.49	-0.51

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 11806. EHP 945.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 145

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 10.0 DEG
SPEED 12.72 FPS DRAG 8.42 LB CF 14.74 IN SKWL 27.33 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	3.052	39	4.66	6.01	6.90	7.70
		1.513		1.40	-0.06	-1.00	-1.23
HEAVE	IN	2.607	22	3.15	3.41	3.60	3.75
		0.364		2.15	1.84	1.74	1.69
DRIVER STA		0.005	52	0.66	1.13	1.66	2.30
ACCEL	G	0.412		-0.37	-0.67	-0.81	-0.90
FWD TROOP		0.005	51	0.60	1.03	1.49	2.04
ACCEL	G	0.362		-0.33	-0.60	-0.73	-0.80
CG		-0.004	50	0.38	0.65	0.98	1.29
ACCEL	G	0.266		-0.28	-0.53	-0.68	-0.75
AFT TROOP		0.003	33	0.25	0.39	0.47	0.55
ACCEL	G	0.180		-0.25	-0.39	-0.50	-0.54

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 14944. EHP 1197.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 147

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 11.0 DEG
SPEED 12.71 FPS DRAG 8.82 LB CP 14.80 IN SKWL 27.43 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 45

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.856	37	4.57	5.89	6.75	7.83
		1.472		1.17	-0.00	-0.76	-1.03
HEAVE	IN	2.618	24	3.09	3.43	3.68	3.93
		0.358		2.18	1.91	1.81	1.77
DRIVER STA		0.005	54	0.64	1.09	1.48	1.79
ACCEL	G	0.409		-0.36	-0.66	-0.87	-0.98
FWD TROOP		0.003	53	0.59	0.97	1.33	1.60
ACCEL	G	0.357		-0.32	-0.59	-0.78	-0.89
CG		-0.003	46	0.40	0.62	0.84	1.00
ACCEL	G	0.261		-0.30	-0.53	-0.71	-0.81
AFT TROOP		0.001	35	0.24	0.37	0.45	0.55
ACCEL	G	0.177		-0.24	-0.38	-0.49	-0.55

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 15649. EHP 1252.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 5-JUL-77

RUN 148

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 12.0 DEG
SPEED 12.72 FPS DRAG 10.51 LB CP 15.08 IN SKWL 29.21 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 49

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	1.376	37	2.73	3.90	4.53	4.79
		1.278		0.02	-1.20	-1.97	-2.31
HEAVE	IN	2.362	21	2.82	3.06	3.23	3.31
		0.317		1.92	1.65	1.50	1.34
DRIVER STA		0.004	53	0.51	0.81	1.09	1.54
ACCEL	G	0.335		-0.35	-0.59	-0.75	-0.88
FWD TROOP		0.000	53	0.44	0.70	0.95	1.31
ACCEL	G	0.291		-0.31	-0.52	-0.66	-0.78
CG		-0.005	44	0.31	0.48	0.62	0.76
ACCEL	G	0.212		-0.28	-0.45	-0.57	-0.64
AFT TROOP		0.009	38	0.22	0.34	0.44	0.51
ACCEL	G	0.161		-0.20	-0.33	-0.42	-0.45

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 18652. EHP 1494.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 25-MAY-77

RUN 68

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 0.0 DEG
SPEED 12.72 FPS DRAG 7.57 LB CP 15.62 IN SKWL 17.67 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 52

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.991	30	11.73	13.23	14.12	14.29
		1.730		7.94	6.55	6.01	5.70
HEAVE	IN	3.278	22	3.88	4.14	4.39	4.51
		0.445		2.63	2.34	2.20	2.16
DRIVER STA		-0.016	64	0.81	1.72	2.45	3.74
ACCEL	G	0.548		-0.49	-0.91	-1.22	-1.42
FWD TROOP		-0.011	64	0.69	1.47	2.14	3.42
ACCEL	G	0.465		-0.42	-0.77	-1.02	-1.19
CG		0.000	59	0.55	1.09	1.61	2.59
ACCEL	G	0.352		-0.33	-0.60	-0.79	-0.86
AFT TROOP		-0.017	45	0.22	0.43	0.67	1.11
ACCEL	G	0.182		-0.24	-0.39	-0.48	-0.60

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 13429. EHP 1076.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 123

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 2.0 DEG
SPEED 12.71 FPS DRAG 6.94 LB CP 15.67 IN SKWL 18.98 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	8.441	31	10.07	11.55	12.43	12.55
		1.690		6.37	4.91	4.09	3.55
HEAVE	IN	3.119	22	3.74	4.13	4.37	4.51
		0.459		2.54	2.19	2.10	2.05
DRIVER STA		-0.011	59	0.83	1.73	2.62	2.70
ACCEL	G	0.497		-0.34	-0.62	-0.77	-0.88
FWD TROOP		-0.002	61	0.77	1.56	2.43	2.69
ACCEL	G	0.448		-0.30	-0.56	-0.69	-0.81
CG		0.001	57	0.58	1.17	1.84	2.16
ACCEL	G	0.340		-0.26	-0.49	-0.63	-0.78
AFT TROOP		-0.012	35	0.28	0.51	0.76	1.06
ACCEL	G	0.181		-0.27	-0.42	-0.54	-0.58

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 12320. EHP 986.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 128

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 3.0 DEG
SPEED 12.71 FPS DRAG 6.90 LB CP 15.72 IN SKWL 19.54 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 46

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.696	34	9.25	10.56	11.64	12.51
		1.619		5.82	4.13	3.07	1.97
HEAVE	IN	3.076	22	3.67	4.07	4.44	4.73
		0.442		2.49	2.23	2.15	2.07
DRIVER STA		-0.005	54	0.90	1.73	2.41	2.93
ACCEL	G	0.495		-0.38	-0.67	-0.79	-0.89
FWD TROOP		0.001	52	0.84	1.57	2.21	2.64
ACCEL	G	0.441		-0.36	-0.61	-0.73	-0.82
CG		0.063	49	0.64	1.12	1.61	1.82
ACCEL	G	0.317		-0.24	-0.46	-0.57	-0.69
AFT TROOP		-0.003	35	0.21	0.35	0.44	0.60
ACCEL	G	0.170		-0.26	-0.38	-0.49	-0.55

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 12242. EHP 980.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 60

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 5.0 DEG
SPEED 12.70 FPS DRAG 7.44 LB CP 15.87 IN SKWL 23.59 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 51

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	6.125	30	7.84	9.15	10.16	10.50
		1.569		3.96	2.45	1.48	0.69
HEAVE	IN	2.725	23	3.24	3.57	3.78	3.88
		0.384		2.22	1.91	1.77	1.73
DRIVER STA		-0.010	53	0.83	1.61	2.44	3.46
ACCEL	G	0.476		-0.37	-0.63	-0.78	-0.86
FWD TROOP		-0.010	51	0.73	1.41	2.09	3.06
ACCEL	G	0.407		-0.34	-0.57	-0.71	-0.77
CG		0.002	48	0.51	0.95	1.50	2.15
ACCEL	G	0.300		-0.30	-0.51	-0.65	-0.69
AFT TROOP		-0.006	34	0.25	0.39	0.49	0.54
ACCEL	G	0.180		-0.24	-0.37	-0.46	-0.49

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 13198. EHP 1055.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 125

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 7.0 DEG
SPEED 12.71 FPS DRAG 8.21 LB CP 16.08 IN SKWL 26.22 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 48

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.655	37	6.18	7.47	8.35	9.20
		1.443		3.01	1.62	0.74	0.29
HEAVE	IN	2.524	22	3.04	3.28	3.50	3.72
		0.370		2.04	1.72	1.63	1.57
DRIVER STA		0.000	54	0.59	0.99	1.33	1.91
ACCEL	G	0.384		-0.34	-0.62	-0.75	-0.84
FWD TROOP		0.004	53	0.53	0.89	1.18	1.72
ACCEL	G	0.337		-0.31	-0.55	-0.67	-0.76
CG		0.010	42	0.39	0.62	0.76	1.09
ACCEL	G	0.251		-0.31	-0.52	-0.62	-0.73
AFT TROOP		0.001	32	0.24	0.37	0.46	0.52
ACCEL	G	0.170		-0.23	-0.36	-0.45	-0.54

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 14567. EHP 1166.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 124

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 10.0 DEG
SPEED 12.71 FPS DRAG 11.03 LB CP 16.58 IN SKWL 29.41 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 0

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.089	38	3.34	4.36	5.05	5.32
		1.145		0.79	-0.17	-0.62	-0.78
HEAVE	IN	2.089	18	2.51	2.63	2.68	2.70
		0.288		1.64	1.41	1.35	1.33
DRIVER STA		-0.001	52	0.43	0.68	0.88	1.55
ACCEL	G	0.290		-0.32	-0.54	-0.68	-0.77
FWD TROOP		0.002	51	0.39	0.61	0.77	1.38
ACCEL	G	0.252		-0.27	-0.48	-0.59	-0.69
CG		0.002	42	0.27	0.43	0.53	0.87
ACCEL	G	0.186		-0.24	-0.39	-0.48	-0.57
AFT TROOP		0.001	37	0.20	0.32	0.36	0.37
ACCEL	G	0.148		-0.20	-0.31	-0.40	-0.48

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 19587. EHP 1568.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 51

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 12.71 FPS DRAG 7.57 LB CP 17.12 IN SKWL 20.48 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 51

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.151	30	10.93	12.44	12.99	13.31
		1.638		7.17	5.68	5.08	5.00
HEAVE	IN	2.850	22	3.49	3.84	3.97	4.00
		0.454		2.26	1.96	1.81	1.69
DRIVER STA		-0.017	52	0.84	1.50	2.10	2.66
ACCEL	G	0.464		-0.37	-0.72	-0.97	-1.24
FWD TROOP		-0.013	51	0.73	1.31	1.82	2.38
ACCEL	G	0.401		-0.33	-0.64	-0.84	-1.05
CG		-0.001	50	0.52	0.90	1.34	1.70
ACCEL	G	0.307		-0.29	-0.54	-0.71	-0.82
AFT TROOP		-0.017	36	0.22	0.36	0.44	0.51
ACCEL	G	0.169		-0.25	-0.40	-0.49	-0.56

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 13443. EHP 1076.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 134

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 2.0 DEG
SPEED 12.71 FPS DRAG 7.72 LB CP 17.29 IN SKWL 22.78 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 50

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.402	35	8.79	9.92	10.93	11.54
		1.457		5.62	4.31	3.58	2.82
HEAVE	IN	2.675	25	3.15	3.48	3.84	3.99
		0.395		2.18	1.90	1.63	1.55
DRIVER STA		-0.013	51	0.71	1.37	1.90	3.02
ACCEL	G	0.410		-0.37	-0.56	-0.71	-0.88
FWD TROOP		-0.007	52	0.64	1.21	1.73	2.77
ACCEL	G	0.364		-0.32	-0.50	-0.65	-0.83
CG		0.003	49	0.45	0.81	1.21	1.81
ACCEL	G	0.274		-0.27	-0.47	-0.65	-0.70
AFT TROOP		-0.011	35	0.21	0.34	0.46	0.54
ACCEL	G	0.162		-0.21	-0.33	-0.44	-0.55

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 13699. EHP 1097.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 136

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 4.0 DEG
SPEED 12.71 FPS DRAG 8.59 LB CP 17.51 IN SKWL 25.92 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.719	39	6.99	8.04	8.62	8.88
		1.281		4.33	3.05	2.35	2.06
HEAVE	IN	2.398	20	2.89	3.13	3.45	3.55
		0.341		1.92	1.64	1.46	1.43
DRIVER STA		-0.012	49	0.52	0.92	1.15	1.42
ACCEL	G	0.338		-0.32	-0.53	-0.71	-0.86
FWD TROOP		-0.005	46	0.50	0.84	1.04	1.33
ACCEL	G	0.297		-0.29	-0.48	-0.63	-0.81
CG		0.006	40	0.35	0.57	0.68	0.93
ACCEL	G	0.227		-0.27	-0.44	-0.58	-0.74
AFT TROOP		-0.016	33	0.19	0.35	0.43	0.45
ACCEL	G	0.151		-0.22	-0.32	-0.43	-0.54

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 15251. EHP 1221.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 54

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 5.0 DEG
SPEED 12.72 FPS DRAG 9.33 LB CP 17.61 IN SKWL 27.49 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 48

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.107	32	6.67	7.72	8.56	9.11
		1.293		3.59	2.43	1.88	1.10
HEAVE	IN	2.185	21	2.69	2.98	3.16	3.24
		0.355		1.73	1.44	1.29	1.20
DRIVER STA		-0.009	50	0.60	1.02	1.54	2.05
ACCEL	G	0.365		-0.31	-0.60	-0.75	-0.96
FWD TROOP		-0.007	50	0.51	0.87	1.32	1.75
ACCEL	G	0.311		-0.27	-0.53	-0.67	-0.88
CG		-0.000	41	0.38	0.62	0.83	1.16
ACCEL	G	0.238		-0.30	-0.50	-0.62	-0.80
AFT TROOP		-0.008	33	0.22	0.35	0.43	0.47
ACCEL	G	0.160		-0.24	-0.37	-0.46	-0.58

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 55030. LB DRAG 16568. EHP 1327.

TABLE A2.5

ROUGH WATER MODEL RESULTS

AT 14.82 fps (35 mph), 31 lb (55,030 lb)

RUN DIRECTORY

LCG, In.	7.66	9.06	10.56	12.06
Flap Angle degrees				
-2				40
0	104	94	87	91
2	100	95	88	92
4	107	96	119	93
5		31	37	55
6	108	114	116	
8	103	98		
10	105	35		

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 104

LOAD 31.0 LB LCG 7.66 IN FLAP ANGLE 0.0 DEG
SPEED 14.84 FPS DRAG 7.19 LB CP 12.82 IN SKWL 10.69 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 43

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.500	17	15.02	17.36	17.81	17.94
		4.501		2.42	0.34	-0.62	-1.15
HEAVE	IN	4.441	17	5.97	6.94	7.31	7.32
		1.161		2.98	2.65	2.58	2.54
DRIVER STA		0.032	48	1.93	4.00	6.23	8.05
ACCEL	G	0.905		-0.34	-0.89	-1.03	-1.11
FWD TROOP		0.013	55	1.65	3.52	5.63	7.78
ACCEL	G	0.852		-0.35	-0.87	-1.06	-1.34
CG		-0.012	53	1.23	2.64	4.13	5.71
ACCEL	G	0.658		-0.41	-0.84	-0.97	-1.16
AFT TROOP		0.013	54	0.51	1.08	1.82	2.84
ACCEL	G	0.393		-0.42	-0.75	-0.87	-0.92

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 12766. EHP 1193.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 100

LOAD 31.0 LB LCG 7.66 IN FLAP ANGLE 2.0 DEG
SPEED 14.86 FPS DRAG 6.50 LB CP 12.83 IN SKWL 12.32 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 44

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.870	21	10.98	12.75	13.27	13.62
		2.802		4.07	1.46	0.84	0.50
HEAVE	IN	4.055	18	5.01	5.72	6.12	6.18
		0.740		3.09	2.83	2.62	2.48
DRIVER STA		-0.014	68	1.41	3.22	5.36	8.39
ACCEL	G	0.863		-0.38	-0.80	-0.98	-1.04
FWD TROOP		0.023	69	1.36	3.12	5.13	8.14
ACCEL	G	0.809		-0.38	-0.77	-0.97	-1.30
CG		-0.010	68	1.02	2.26	3.68	5.80
ACCEL	G	0.611		-0.37	-0.71	-0.86	-0.97
AFT TROOP		0.016	60	0.46	0.89	1.36	1.62
ACCEL	G	0.306		-0.29	-0.57	-0.77	-0.92

FROUDE SCALE DATA
SPEED 35.1 MPH LOAD 55030. LB DRAG 11540. EHP 1080.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 30-JUN-77

RUN 107

LOAD 31.0 LB LCG 7.66 IN FLAP ANGLE 4.0 DEG
SPEED 14.84 FPS DRAG 5.97 LB CP 12.88 IN SKWL 14.56 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 43

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.935	22	8.76	10.41	11.61	13.01
		2.469		2.41	0.62	-0.05	-0.50
HEAVE	IN	3.681	23	4.41	5.07	5.51	5.91
		0.639		2.92	2.67	2.44	2.22
DRIVER STA		0.034	64	1.45	2.85	4.01	5.14
ACCEL	G	0.754		-0.27	-0.76	-0.94	-1.10
FWD TROOP		0.031	63	1.37	2.76	3.87	4.89
ACCEL	G	0.687		-0.31	-0.73	-0.95	-1.35
CG		0.002	42	1.04	2.08	3.04	3.71
ACCEL	G	0.537		-0.31	-0.66	-0.86	-1.14
AFT TROOP		0.035	57	0.48	0.97	1.62	2.09
ACCEL	G	0.298		-0.27	-0.55	-0.74	-0.86

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 10600. EHP 991.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 30-JUN-77

RUN 108

LOAD 31.0 LB LCG 7.66 IN FLAP ANGLE 6.0 DEG
SPEED 14.82 FPS DRAG 6.08 LB CP 12.97 IN SKWL 16.98 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 44

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.543	28	6.66	8.31	9.66	10.55
		2.091		1.88	-0.04	-0.79	-1.25
HEAVE	IN	3.439	23	4.08	4.65	5.05	5.30
		0.538		2.78	2.52	2.28	2.11
DRIVER STA		0.033	64	1.42	2.78	4.14	5.52
ACCEL	G	0.742		-0.35	-0.76	-0.92	-1.02
FWD TROOP		0.025	65	1.30	2.60	3.97	5.21
ACCEL	G	0.674		-0.36	-0.73	-0.89	-1.26
CG		-0.000	63	0.98	1.98	3.01	4.11
ACCEL	G	0.519		-0.34	-0.67	-0.81	-0.97
AFT TROOP		0.021	57	0.39	0.76	1.11	1.86
ACCEL	G	0.265		-0.24	-0.48	-0.61	-0.69

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 10786. EHP 1007.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 103

LOAD 31.0 LB LCG 7.66 IN FLAP ANGLE 8.0 DEG
SPEED 14.84 FPS DRAG 6.65 LB CF 13.14 IN SKWL 20.51 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.987	32	4.75	6.49	7.70	8.44
		1.907		0.78	-0.96	-1.90	-2.67
HEAVE	IN	3.262	22	3.87	4.42	4.60	4.75
		0.486		2.67	2.38	2.18	1.92
DRIVER STA		0.055	59	1.35	2.52	3.67	4.70
ACCEL	G	0.678		-0.31	-0.73	-0.89	-0.96
FWD TROOP		0.025	62	1.20	2.33	3.40	4.46
ACCEL	G	0.633		-0.33	-0.71	-0.87	-0.93
CG		-0.008	59	0.86	1.67	2.48	3.11
ACCEL	G	0.469		-0.32	-0.66	-0.83	-0.93
AFT TROOP		0.025	48	0.33	0.61	0.88	1.20
ACCEL	G	0.243		-0.25	-0.49	-0.64	-0.80

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 11810. EHP 1104.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 105

LOAD 31.0 LB LCG 7.66 IN FLAP ANGLE 10.0 DEG
SPEED 14.84 FPS DRAG 7.68 LB CP 13.34 IN SKWL 26.14 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 46

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	1.608	34	3.40	4.97	6.11	6.79
		1.830		-0.49	-2.26	-2.93	-3.20
HEAVE	IN	3.032	21	3.59	4.03	4.16	4.31
		0.421		2.51	2.25	2.04	1.92
DRIVER STA		0.026	60	1.12	2.24	3.30	4.71
ACCEL	G	0.635		-0.40	-0.79	-0.94	-1.01
FWD TROOP		0.024	62	1.05	2.08	2.98	4.44
ACCEL	G	0.585		-0.35	-0.73	-0.87	-0.93
CG		-0.004	57	0.73	1.44	2.08	2.97
ACCEL	G	0.419		-0.33	-0.69	-0.83	-0.91
AFT TROOP		0.028	44	0.28	0.52	0.72	1.17
ACCEL	G	0.228		-0.26	-0.48	-0.61	-0.78

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 13638. EHP 1274.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 94

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 0.0 DEG
SPEED 14.83 FPS DRAG 6.72 LB CP 14.17 IN SKWL 13.48 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	8.828	22	11.75	13.78	15.29	16.48
		2.871		4.83	2.51	1.39	0.39
HEAVE	IN	3.946	20	4.87	5.63	6.33	6.33
		0.767		3.05	2.63	2.39	2.38
DRIVER STA		0.005	60	1.32	2.83	4.83	6.17
ACCEL	G	0.773		-0.37	-0.76	-0.96	-1.18
FWD TROOP		0.009	62	1.27	2.71	4.37	6.23
ACCEL	G	0.721		-0.34	-0.72	-0.89	-1.05
CG		0.002	58	0.98	1.95	3.27	4.29
ACCEL	G	0.530		-0.33	-0.66	-0.84	-0.92
AFT TROOP		-0.008	60	0.40	0.77	1.31	2.41
ACCEL	G	0.308		-0.31	-0.63	-0.89	-1.19

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 11934. EHP 1115.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 95

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 2.0 DEG
SPEED 14.84 FPS DRAG 6.24 LB CP 14.21 IN SKWL 14.72 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 46

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.349	27	9.70	11.73	13.07	14.36
		2.398		4.44	2.07	0.95	0.37
HEAVE	IN	3.710	21	4.51	5.19	5.55	5.79
		0.649		2.94	2.60	2.37	2.25
DRIVER STA		0.028	64	1.44	2.94	4.48	5.37
ACCEL	G	0.766		-0.37	-0.76	-0.92	-1.08
FWD TROOP		0.010	66	1.34	2.82	4.38	5.24
ACCEL	G	0.724		-0.40	-0.76	-0.93	-1.04
CG		0.004	65	1.00	2.03	3.27	3.83
ACCEL	G	0.543		-0.34	-0.68	-0.82	-0.93
AFT TROOP		-0.003	58	0.41	0.79	1.33	2.25
ACCEL	G	0.296		-0.31	-0.59	-0.74	-0.93

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 11083. EHP 1036.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 96

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 4.0 DEG
SPEED 14.84 FPS DRAG 6.24 LB CP 14.30 IN SKWL 16.79 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 44

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.921	30	7.76	9.54	10.70	11.29
		2.030		3.50	1.63	0.58	0.49
HEAVE	IN	3.451	22	4.11	4.72	5.03	5.22
		0.549		2.79	2.52	2.23	1.94
DRIVER STA		0.024	63	1.46	2.99	4.44	5.64
ACCEL	G	0.747		-0.39	-0.76	-0.90	-1.05
FWD TROOP		0.010	66	1.34	2.79	4.29	5.41
ACCEL	G	0.705		-0.40	-0.73	-0.88	-1.01
CG		-0.000	65	0.96	1.96	3.05	3.79
ACCEL	G	0.519		-0.34	-0.63	-0.78	-0.95
AFT TROOP		0.001	52	0.36	0.72	1.14	2.05
ACCEL	G	0.271		-0.29	-0.54	-0.66	-0.78

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 11080. EHP 1035.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 23-MAY-77

RUN 31

LOAD 31.0 LB LCG 9.06 IN FLAP ANGLE 5.0 DEG
SPEED 14.83 FPS DRAG 6.19 LB CP 14.33 IN SKWL 19.80 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 46

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.113	29	7.01	8.48	9.14	9.42
		1.893		2.76	0.91	0.02	-0.36
HEAVE	IN	3.165	22	3.80	4.25	4.34	4.39
		0.471		2.57	2.31	2.09	1.90
DRIVER STA		0.008	59	1.33	2.64	3.81	5.36
ACCEL	G	0.712		-0.43	-0.82	-0.93	-0.94
FWD TROOP		0.007	59	1.16	2.33	3.39	4.76
ACCEL	G	0.622		-0.41	-0.75	-0.87	-0.90
CG		0.002	58	0.86	1.68	2.50	3.45
ACCEL	G	0.473		-0.36	-0.68	-0.79	-0.85
AFT TROOP		0.003	45	0.35	0.65	0.78	0.82
ACCEL	G	0.253		-0.29	-0.51	-0.61	-0.67

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 10996. EHP 1027.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 114,115

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 6.0 DEG
SPEED 14.83 FPS DRAG 6.58 LB CP 14.44 IN SKWL 20.18 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 95

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.453	62	6.15	7.66	9.04	9.97
		1.766		2.35	0.75	-0.48	-1.47
HEAVE	IN	3.191	48	3.73	4.23	4.72	5.05
		0.462		2.65	2.31	2.11	2.06
DRIVER STA		-0.003	118	1.21	2.42	3.53	4.37
ACCEL	G	0.676		-0.37	-0.74	-0.93	-1.02
FWD TROOP		0.004	122	1.09	2.19	3.26	4.10
ACCEL	G	0.595		-0.32	-0.66	-0.84	-0.94
CG		-0.002	115	0.80	1.57	2.38	2.94
ACCEL	G	0.446		-0.31	-0.61	-0.80	-0.95
AFT TROOP		0.001	88	0.32	0.57	0.76	1.51
ACCEL	G	0.243		-0.26	-0.51	-0.74	-1.12

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 11679. EHP 1091.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 98

LOAD 31.0 LB LCG 9.08 IN FLAP ANGLE 8.0 DEG
SPEED 14.86 FPS DRAG 7.76 LB CP 14.66 IN SKWL 24.57 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 50

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	3.107	34	4.94	6.61	7.25	7.43
		1.719		1.11	-0.28	-1.11	-1.64
HEAVE	IN	2.978	22	3.54	3.92	4.06	4.21
		0.403		2.44	2.19	2.13	2.11
DRIVER STA		0.012	59	1.08	2.03	2.83	3.42
ACCEL	G	0.621		-0.45	-0.80	-0.93	-1.10
FWD TROOP		0.012	62	0.98	1.86	2.55	3.25
ACCEL	G	0.568		-0.40	-0.74	-0.87	-1.02
CG		-0.002	56	0.68	1.22	1.71	2.21
ACCEL	G	0.401		-0.36	-0.66	-0.79	-0.94
AFT TROOP		0.007	44	0.28	0.51	0.67	0.83
ACCEL	G	0.242		-0.27	-0.47	-0.59	-0.73

FROUDE SCALE DATA
SPEED 35.1 MPH LOAD 55030. LB DRAG 13767. EHP 1288.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 35

LOAD 31.0 LB LCG 9.06 IN FLAP ANGLE 10.0 DEG
SPEED 14.84 FPS DRAG 10.16 LB CP 15.04 IN SKWL 28.98 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 45

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	1.138	35	2.67	3.85	4.56	4.91
		1.495		-0.57	-2.00	-2.66	-2.95
HEAVE	IN	2.546	19	3.01	3.28	3.43	3.49
		0.340		2.05	1.87	1.77	1.71
DRIVER STA		0.002	60	0.75	1.50	2.25	2.78
ACCEL	G	0.516		-0.40	-0.79	-0.99	-1.05
FWD TROOP		0.002	55	0.70	1.30	1.92	2.43
ACCEL	G	0.437		-0.36	-0.70	-0.86	-0.94
CG		-0.002	47	0.50	0.87	1.26	1.60
ACCEL	G	0.315		-0.33	-0.60	-0.73	-0.83
AFT TROOP		0.006	35	0.27	0.46	0.57	0.67
ACCEL	G	0.218		-0.28	-0.44	-0.51	-0.55

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 18041. EHP 1686.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 87

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 0.0 DEG
SPEED 14.83 FPS DRAG 6.48 LB CP 15.66 IN SKWL 16.21 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 50

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.885	27	9.76	11.31	12.61	13.10
		1.924		5.72	3.83	2.17	1.09
HEAVE	IN	3.524	20	4.21	4.70	5.43	5.46
		0.527		2.93	2.51	2.39	2.36
DRIVER STA		0.009	58	1.23	2.48	3.72	5.60
ACCEL	G	0.644		-0.33	-0.67	-0.81	-0.93
FWD TROOP		0.006	59	1.18	2.39	3.56	5.30
ACCEL	G	0.602		-0.33	-0.64	-0.77	-0.89
CG		0.007	57	0.87	1.76	2.48	3.56
ACCEL	G	0.443		-0.30	-0.58	-0.72	-0.84
AFT TROOP		-0.008	51	0.34	0.71	1.13	1.94
ACCEL	G	0.244		-0.31	-0.56	-0.84	-1.33

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 11507. EHP 1075.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 88

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 2.0 DEG
SPEED 14.82 FPS DRAG 6.41 LB CP 15.74 IN SKWL 17.25 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 43

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	6.697	29	8.51	10.05	10.86	11.37
		1.857		4.55	2.78	1.76	1.60
HEAVE	IN	3.396	20	4.05	4.56	4.80	4.86
		0.497		2.76	2.47	2.15	2.02
DRIVER STA		-0.006	60	1.16	2.27	3.46	5.34
ACCEL	G	0.631		-0.36	-0.71	-0.87	-0.94
FWD TROOP		-0.002	63	1.09	2.14	3.29	5.26
ACCEL	G	0.592		-0.33	-0.67	-0.83	-0.91
CG		-0.005	63	0.76	1.50	2.40	3.75
ACCEL	G	0.438		-0.30	-0.59	-0.75	-0.88
AFT TROOP		-0.013	53	0.33	0.64	1.04	2.16
ACCEL	G	0.247		-0.27	-0.52	-0.69	-1.06

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 11379. EHP 1062.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 119,120

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 4.0 DEG
SPEED 14.85 FPS DRAG 6.90 LB CP 15.90 IN SKWL 21.59 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 92

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.182	64	6.85	8.07	9.01	9.25
		1.607		3.32	1.78	0.59	-0.17
HEAVE	IN	3.020	45	3.55	4.03	4.34	4.72
		0.429		2.49	2.17	1.98	1.89
DRIVER STA		0.001	114	1.13	2.15	3.26	4.45
ACCEL	G	0.619		-0.38	-0.74	-0.90	-1.02
FWD TROOP		0.003	118	1.01	1.95	3.08	4.34
ACCEL	G	0.547		-0.34	-0.66	-0.82	-0.93
CG		0.011	114	0.74	1.40	2.17	3.33
ACCEL	G	0.409		-0.29	-0.58	-0.74	-0.88
AFT TROOP		-0.009	86	0.31	0.54	0.79	1.20
ACCEL	G	0.230		-0.28	-0.50	-0.63	-0.72

FROUDE SCALE DATA
SPEED 35.1 MPH LOAD 55030. LB DRAG 12249. EHP 1146.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 37

LOAD 31.0 LB LCG 10.56 IN FLAP ANGLE 5.0 DEG
SPEED 14.81 FPS DRAG 7.38 LB CP 15.98 IN SKWL 24.12 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 53

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.455	33	6.20	7.87	8.62	9.55
		1.762		2.49	0.77	-0.13	-0.94
HEAVE	IN	2.861	20	3.47	3.82	4.17	4.27
		0.442		2.26	1.98	1.83	1.76
DRIVER STA		-0.005	55	1.04	2.04	2.87	3.98
ACCEL	G	0.598		-0.42	-0.75	-0.87	-0.97
FWD TROOP		-0.009	54	0.91	1.80	2.49	3.44
ACCEL	G	0.514		-0.39	-0.68	-0.81	-0.92
CG		-0.001	50	0.64	1.23	1.78	2.31
ACCEL	G	0.382		-0.32	-0.60	-0.74	-0.78
AFT TROOP		-0.006	38	0.31	0.55	0.70	0.89
ACCEL	G	0.233		-0.28	-0.47	-0.61	-0.69

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 13100. EHP 1222.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 1-JUL-77

RUN 116

LOAD 31.0 LB LCG 10.58 IN FLAP ANGLE 6.0 DEG
SPEED 14 84 FPS DRAG 7.77 LB CP 16.08 IN SKWL 24.94 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 46

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	3.903	32	5.59	6.83	7.61	8.36
		1.503		2.16	0.83	0.08	-0.32
HEAVE	IN	2.821	23	3.29	3.65	3.87	3.97
		0.377		2.35	2.04	1.87	1.76
DRIVER STA		0.005	55	0.94	1.93	2.83	3.76
ACCEL	G	0.559		-0.39	-0.73	-0.90	-0.97
FWD TROOP		0.004	55	0.84	1.74	2.59	3.48
ACCEL	G	0.488		-0.35	-0.65	-0.82	-0.89
CG		0.017	49	0.64	1.25	1.82	2.41
ACCEL	G	0.360		-0.30	-0.56	-0.73	-0.82
AFT TROOP		-0.004	40	0.26	0.44	0.56	0.64
ACCEL	G	0.216		-0.26	-0.45	-0.59	-0.64

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 13787. EHP 1288.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 40

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE -2.0 DEG
SPEED 14.83 FPS DRAG 7.34 LB CF 17.11 IN SKWL 17.82 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 48

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	8.906	23	11.35	13.10	14.30	15.89
		2.219		6.03	4.43	3.79	3.60
HEAVE	IN	3.279	20	3.93	4.38	5.04	5.42
		0.567		2.61	2.24	1.92	1.90
DRIVER STA		-0.010	51	0.98	1.89	2.36	2.64
ACCEL	G	0.585		-0.47	-0.97	-1.37	-1.88
FWD TROOP		0.004	50	0.86	1.59	2.08	2.23
ACCEL	G	0.493		-0.41	-0.82	-1.17	-1.54
CG		0.009	50	0.64	1.14	1.46	1.75
ACCEL	G	0.380		-0.34	-0.68	-0.95	-1.23
AFT TROOP		-0.009	54	0.28	0.58	0.87	1.63
ACCEL	G	0.245		-0.28	-0.49	-0.62	-0.70

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 13022. EHP 1216.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 91

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 0.0 DEG
SPEED 14.82 FPS DRAG 6.94 LB CP 17.19 IN SKWL 18.46 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 43

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	7.576	25	9.47	10.93	11.86	12.16
		1.789		5.33	3.77	2.63	2.27
HEAVE	IN	3.225	21	7.83	4.39	4.69	4.77
		0.491		2.62	2.39	2.21	1.99
DRIVER STA		-0.009	56	1.06	2.09	3.15	3.97
ACCEL	G	0.573		-0.34	-0.67	-0.84	-0.91
FWD TROOP		-0.010	61	0.93	1.89	2.86	3.63
ACCEL	G	0.532		-0.32	-0.63	-0.80	-0.88
CG		-0.002	60	0.68	1.35	1.99	2.23
ACCEL	G	0.389		-0.27	-0.56	-0.73	-0.81
AFT TROOP		-0.012	46	0.33	0.57	0.90	1.23
ACCEL	G	0.220		-0.30	-0.52	-0.65	-0.83

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 12324. EHP 1151.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 92106

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 2.0 DEG
SPEED 14.86 FPS DRAG 7.28 LB CP 17.34 IN SKWL 21.54 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 92

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	6.122	59	7.69	9.07	9.88	10.57
		1.543		4.19	2.77	1.63	0.99
HEAVE	IN	2.944	42	3.50	3.95	4.18	4.60
		0.425		2.44	2.13	1.88	1.79
DRIVER STA		-0.001	109	0.98	1.93	2.90	4.56
ACCEL	G	0.543		-0.34	-0.66	-0.81	-0.93
FWD TROOP		-0.002	113	0.92	1.81	2.76	4.52
ACCEL	G	0.506		-0.31	-0.62	-0.78	-0.90
CG		0.001	111	0.64	1.25	1.93	3.09
ACCEL	G	0.370		-0.26	-0.54	-0.67	-0.84
AFT TROOP		-0.008	87	0.27	0.52	0.80	1.71
ACCEL	G	0.209		-0.25	-0.44	-0.59	-0.78

FROUDE SCALE DATA
SPEED 35.1 MPH LOAD 55030. LB DRAG 12919. EHP 1209.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 28-JUN-77

RUN 93

LOAD 31.0 LB LCG 12.08 IN FLAP ANGLE 4.0 DEG
SPEED 14.82 FPS DRAG 8.24 LB CP 17.55 IN SKWL 24.93 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 46

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.719	33	6.18	7.26	7.79	8.01
		1.443		2.88	1.55	1.01	0.22
HEAVE	IN	2.706	21	3.21	3.55	3.64	3.71
		0.370		2.22	1.96	1.77	1.76
DRIVER STA		-0.001	54	0.82	1.57	2.22	3.09
ACCEL	G	0.486		-0.37	-0.67	-0.81	-0.89
FWD TROOP		-0.005	56	0.76	1.46	2.11	3.01
ACCEL	G	0.448		-0.32	-0.62	-0.78	-0.87
CG		-0.003	50	0.52	0.97	1.44	2.14
ACCEL	G	0.321		-0.29	-0.55	-0.71	-0.81
AFT TROOP		-0.003	38	0.24	0.42	0.57	0.59
ACCEL	G	0.199		-0.25	-0.43	-0.53	-0.63

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 14634. EHP 1366.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 55

LOAD 31.0 LB LCG 12.06 IN FLAP ANGLE 5.0 DEG
SPEED 14.84 FPS DRAG 9.16 LB CP 17.67 IN SKWL 27.10 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 48

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.119	33	5.67	6.92	7.59	8.45
		1.470		2.42	1.08	0.13	-0.48
HEAVE	IN	2.471	20	3.00	3.28	3.42	3.45
		0.370		1.96	1.72	1.51	1.45
DRIVER STA		-0.005	45	0.85	1.54	2.25	3.46
ACCEL	G	0.494		-0.46	-0.73	-0.88	-0.97
FWD TROOP		-0.010	47	0.71	1.27	1.92	2.97
ACCEL	G	0.423		-0.38	-0.65	-0.80	-0.88
CG		-0.001	46	0.49	0.84	1.26	1.98
ACCEL	G	0.316		-0.31	-0.58	-0.73	-0.81
AFT TROOP		-0.005	34	0.24	0.42	0.54	0.65
ACCEL	G	0.206		-0.28	-0.42	-0.52	-0.58

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 55030. LB DRAG 16254. EHP 1519.

TABLE A2.6

ROUGH WATER MODEL RESULTS

AT 33.8 lb (60,000 lb), 12.06 in. LCG

RUN DIRECTORY

Flap Angle, degrees	0	5
Equivalent Ship Speed, mph		
20	43	47
25	44	48
30	45	49
35	46	50

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 43

LOAD 33.8 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 8.48 FPS DRAG 10.42 LB CP 17.34 IN SKWL 29.74 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 56

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	8.112	32	9.47	10.41	10.83	11.11
		1.099		6.71	5.95	5.50	5.29
HEAVE	IN	0.541	23	0.96	1.18	1.32	1.41
		0.287		0.11	-0.04	-0.14	-0.18
DRIVER STA		-0.011	42	0.25	0.37	0.43	0.48
ACCEL	G	0.170		-0.26	-0.38	-0.42	-0.44
FWD TROOP		-0.013	40	0.21	0.31	0.36	0.41
ACCEL	G	0.143		-0.23	-0.33	-0.37	-0.40
CG		-0.002	34	0.18	0.24	0.27	0.32
ACCEL	G	0.113		-0.21	-0.29	-0.31	-0.35
AFT TROOP		-0.009	27	0.13	0.18	0.22	0.26
ACCEL	G	0.083		-0.16	-0.21	-0.23	-0.25

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 60019. LB DRAG 18499. EHP 988.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 44

LOAD 33.8 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 10.59 FPS DRAG 9.83 LB CP 17.06 IN SKWL 24.52 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	10.630	32	12.25	13.30	13.77	14.01
		1.297		9.04	7.97	7.34	6.86
HEAVE	IN	1.921	23	2.40	2.66	2.83	2.97
		0.337		1.43	1.22	1.10	1.05
DRIVER STA		-0.025	47	0.48	0.84	1.15	1.55
ACCEL	G	0.288		-0.33	-0.48	-0.60	-0.75
FWD TROOP		-0.016	44	0.42	0.73	0.97	1.33
ACCEL	G	0.245		-0.30	-0.43	-0.53	-0.68
CG		-0.004	43	0.30	0.49	0.65	0.85
ACCEL	G	0.189		-0.25	-0.36	-0.47	-0.62
AFT TROOP		-0.027	31	0.16	0.25	0.30	0.32
ACCEL	G	0.114		-0.18	-0.26	-0.33	-0.40

FROUDE SCALE DATA
SPEED 25.0 MPH LOAD 60018. LB DRAG 17457. EHP 1164.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 45

LOAD 33.8 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 12.71 FPS DRAG 8.47 LB CP 17.02 IN SKWL 20.30 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 46

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	9.706	27	11.44	12.65	13.41	14.31
		1.524		7.72	6.33	5.66	4.95
HEAVE	IN	2.842	21	3.40	3.75	3.88	4.04
		0.399		2.31	2.02	1.82	1.81
DRIVER STA		-0.015	46	0.74	1.39	2.08	3.09
ACCEL	G	0.401		-0.36	-0.63	-0.77	-0.86
FWD TROOP		-0.010	46	0.64	1.21	1.80	2.70
ACCEL	G	0.347		-0.32	-0.56	-0.68	-0.73
CG		-0.002	41	0.49	0.90	1.26	1.87
ACCEL	G	0.264		-0.31	-0.49	-0.57	-0.63
AFT TROOP		-0.014	36	0.19	0.33	0.43	0.52
ACCEL	G	0.144		-0.22	-0.34	-0.42	-0.47

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 60018. LB DRAG 15032. EHP 1203.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 46

LOAD 33.8 LB LCG 12.06 IN FLAP ANGLE 0.0 DEG
SPEED 14.82 FPS DRAG 7.66 LB CF 17.08 IN SKWL 19.42 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 44

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	8.098	26	10.01	11.44	12.31	12.73
		1.740		5.97	4.46	3.69	3.18
HEAVE	IN	3.072	18	3.78	4.17	4.23	4.24
		0.451		2.45	2.24	2.08	1.87
DRIVER STA		-0.007	52	0.95	1.80	2.74	5.26
ACCEL	G	0.542		-0.40	-0.79	-1.10	-1.68
FWD TROOP		0.002	50	0.88	1.65	2.66	4.74
ACCEL	G	0.477		-0.38	-0.72	-1.01	-1.42
CG		0.005	50	0.65	1.19	1.98	3.36
ACCEL	G	0.366		-0.32	-0.60	-0.84	-1.09
AFT TROOP		-0.010	45	0.26	0.54	0.87	1.79
ACCEL	G	0.212		-0.29	-0.48	-0.65	-0.86

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 60018. LB DRAG 13593. EHP 1269.

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 47

LOAD 33.8 LB LCG 12.06 IN FLAP ANGLE 5.0 DEG
SPEED 8.47 FPS DRAG 9.48 LB CP 17.70 IN SKWL 31.74 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 54

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	2.858	30	4.24	4.97	5.42	5.80
		1.063		1.42	0.59	-0.05	-0.50
HEAVE	IN	0.255	24	0.62	0.83	0.92	0.97
		0.259		-0.12	-0.30	-0.40	-0.58
DRIVER STA		-0.009	42	0.23	0.36	0.44	0.49
ACCEL	G	0.147		-0.22	-0.32	-0.36	-0.41
FWD TROOP		-0.011	35	0.21	0.30	0.36	0.38
ACCEL	G	0.122		-0.21	-0.29	-0.33	-0.36
CG		-0.008	31	0.17	0.21	0.24	0.27
ACCEL	G	0.095		-0.18	-0.24	-0.27	-0.27
AFT TROOP		-0.007	29	0.13	0.17	0.21	0.23
ACCEL	G	0.083		-0.15	-0.21	-0.24	-0.25

FROUDE SCALE DATA
SPEED 20.0 MPH LOAD 60018. LB DRAG 16831. EHP 898.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 48

LOAD 33.8 LB LCG 12.06 IN FLAP ANGLE 5.0 DEG
SPEED 10.58 FPS DRAG 11.06 LB CF 17.57 IN SKWL 29.14 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 53

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	6.120	31	7.51	8.36	8.78	9.04
		1.093		4.75	3.81	3.03	1.86
HEAVE	IN	1.384	21	1.82	2.05	2.12	2.14
		0.297		0.97	0.76	0.68	0.63
DRIVER STA		-0.012	45	0.36	0.59	0.83	1.57
ACCEL	G	0.229		-0.28	-0.45	-0.57	-0.65
FWD TROOP		-0.007	43	0.32	0.50	0.70	1.29
ACCEL	G	0.193		-0.23	-0.38	-0.49	-0.59
CG		-0.001	37	0.23	0.35	0.50	0.78
ACCEL	G	0.151		-0.22	0.34	-0.45	-0.51
AFT TROOP		-0.007	29	0.16	0.24	0.30	0.32
ACCEL	G	0.108		-0.17	-0.24	-0.31	-0.37

FROUDE SCALE DATA

SPEED 25.0 MPH LOAD 60018. LB DRAG 19636. EHP 1309.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 49

LOAD 33.8 LB LCG 12.06 IN FLAP ANGLE 5.0 DEG
SPEED 12.71 FPS DRAG 10.05 LB CP 17.51 IN SKWL 26.89 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 51

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	5.692	31	7.15	8.14	8.84	9.69
		1.296		3.99	2.94	2.46	1.89
HEAVE	IN	2.248	21	2.69	2.98	3.17	3.44
		0.333		1.79	1.55	1.37	1.19
DRIVER STA		-0.012	42	0.54	0.89	1.20	2.35
ACCEL	G	0.335		-0.36	-0.59	-0.72	-0.80
FWD TROOP		-0.007	40	0.49	0.75	1.08	2.00
ACCEL	G	0.285		-0.31	-0.51	-0.65	-0.71
CG		-0.001	35	0.35	0.52	0.70	1.29
ACCEL	G	0.217		-0.29	-0.46	-0.58	-0.67
AFT TROOP		-0.008	29	0.22	0.33	0.38	0.39
ACCEL	G	0.147		-0.21	-0.29	-0.37	-0.41

FROUDE SCALE DATA
SPEED 30.0 MPH LOAD 60018. LB DRAG 17837. EHP 1428.

LR - 1957

DAVIDSON LABORATORY MACDEC LVA 1/12 - SCALE MODEL DATA 24-MAY-77

RUN 50

LOAD 33.8 LB LCG 12.06 IN FLAP ANGLE 5.0 DEG
SPEED 14.83 FPS DRAG 9.89 LB CP 17.60 IN SKWL 26.36 IN
SIGNIFICANT WAVE HEIGHT 2.20 IN WAVE ENCOUNTERS 47

		MEAN/RMS	OSC	AVG	1/3	1/10	EXTREME
PITCH	DEG	4.508	32	5.96	7.18	7.63	7.73
		1.456		2.74	1.53	0.60	0.10
HEAVE	IN	2.528	19	3.07	3.31	3.52	3.56
		0.359		2.03	1.81	1.66	1.57
DRIVER STA		-0.006	46	0.80	1.53	2.22	3.12
ACCEL	G	0.462		-0.40	-0.68	-0.80	-0.94
FWD TROOP		-0.006	45	0.69	1.34	1.93	2.82
ACCEL	G	0.396		-0.36	-0.62	-0.73	-0.89
CG		-0.000	39	0.52	0.94	1.39	2.10
ACCEL	G	0.296		-0.33	-0.56	-0.66	-0.77
AFT TROOP		-0.002	32	0.25	0.40	0.48	0.50
ACCEL	G	0.191		-0.26	-0.42	-0.53	-0.64

FROUDE SCALE DATA
SPEED 35.0 MPH LOAD 60018. LB DRAG 17561. EHP 1640.